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ABSTRACT

This manual represents the results of a North Carolina Department of Community Colleges project to update the machinist curriculum using performance competencies as a basis for determining curriculum content and objectives. Chapter I provides information on program implementation; curriculum design; faculty selection, workload, and responsibilities; facility and equipment requirements; instructional materials; library support; and liaisons with machine shop associations. Chapter II describes the activities of the curriculum development project, including appointing curriculum committees, identifying instructional resources, surveying selected industries to determine training needs, listing and validating machinist tasks by job levels, analyzing tasks, writing competencies and evaluative criteria, specifying tasks by educational level, proposing course content, developing course descriptions and a curriculum guide, and providing information on available resources. Chapter III presents job descriptions for machinists, machine set-up operators, and machine operators. Chapter IV presents the curriculum guide, which suggests a four-quarter series of machine shop, math, and general education courses; and provides descriptions and detailed outlines for each, specifying objectives, activities, and texts. Chapter V provides a list of necessary equipment, and Chapter VI identifies selected instructional resources for the machinist curriculum. The appendices provide survey results and job and task analyses. (AYC)

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MACHINIST

Curriculum Manual

January, 1979

Coordinated by

Frank A. Gourley, Jr.

Department of Community Colleges

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PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
RALEIGH, NORTH CAROLINA

JC 810170

FOREWORD

The Department of Community Colleges encourages institutions to continually review and update curriculums designed to prepare students for employment. The Machinist Curriculum Manual represents an effort coordinated by the Department to update the machinist curriculum using performance competencies as a basis for determining curriculum content and objectives. Most of the institutions offering the machinist curriculum have had input into this curriculum manual. Also, many machining industries and employers across the state responded to questionnaires during the project. We feel the Machinist Curriculum Manual represents the current best thinking of instructors and employers involved with this program.

Staff of the Program Development Section and the Machinist Competency Committee recommend the curriculum to you. These individuals are available to discuss specific concepts of the curriculum with you.

Roger G. Worthington

Roger G. Worthington, Director
Program Development Division
Department of Community Colleges

Charles R. Holloman

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Curriculum Standards

STATE BOARD OF EDUCATION
NORTH CAROLINA DEPARTMENT OF COMMUNITY COLLEGES
RALEIGH, NORTH CAROLINA

PROGRAM AREA

MECHANICAL-MANUFACTURING

CURRICULUM CODE & TITLE

V032 MACHINIST

CURRICULUM DESCRIPTION

This curriculum is designed to train machinists by providing theory and practice in a variety of metal machining operations. Related courses including blueprint reading, metallurgy, math and science help provide additional basic skills necessary to the machinist trade. The machinist is a skilled metal worker who shapes metal parts by using machine tools and hand tools. The machinist must be able to set up and operate the machine tools found in a modern shop. The machinist is able to select the proper tools and material required for each job and to plan the cutting and finishing operations in their proper order so that the work can be completed according to blueprint or written specifications. The machinist makes standard shop computations relating to dimensions of work, tooling, feeds, and speeds of machining. Precision measuring instruments, such as micrometers and gauges are used to measure the accuracy of work.

The machinist also must know the characteristics of metals so that annealing and hardening of tools and parts can be accomplished in the process of turning. a block of metal into an intricate, precise part.

JOB OPPORTUNITIES

Entry Level	Advanced Level
Machine Operator	General Machinist
Machine Set-Up Operator	Production Foreman
Apprentice Machinist	Tool/Die/Mold Maker
Tool/Die/Mold Maker Apprentice	Maintenance Machinist
Maintenance Helper	Tape Control Programmer
Machine Tool Technician	
Quality Control Technician	

CURRICULUM STANDARDS

STATE BOARD OF EDUCATION APPROVAL	MINIMUM/MAXIMUM RANGE OF QUARTER HOUR CREDITS			
	Technical	Technical Specialty	Vocational	Vocational Specialty
TECHNICAL/VOCATIONAL (MAJOR)				
Machine Shop Theory and Practice			28-32	
RELATED			29-37	
Blueprint Reading Industrial Safety Metallurgy Welding Mathematics Applied Science				
GENERAL EDUCATION			6-8	
Reading Improvement Communication Skills Human Relations				
ELECTIVES			3	
COOPERATIVE EDUCATION/INTERNSHIP				
RANGE OF QUARTER HOUR CREDITS				
MIN.			66	
MAX.			73	
MINIMUM PERCENTAGE OF QHC AWARDED ON 1:1 (CLASSWORK) RATIO			65%	
APPROVED FOR AWARDING			Diploma	

ACKNOWLEDGEMENTS

Many individuals contributed to the completion of this publication. Their assistance and cooperation is appreciated.

Appreciation is especially extended to those machinist instructors who served on the curriculum committee. It is their creative effort and hard work that has resulted in the materials included in the manual. Their close ties with the training needs of local industries was reinforced throughout the validation process. Their response to the project resulted in the development of updated concepts included in the manual. They have explained and supported the curriculum in meetings with their counterparts to assure that other instructors understand their work. Instructors actively serving on the committee included Vernon Teeter, Beaufort County Technical Institute; Tom Tucker, Catawba Valley Technical Institute; Randall Jones, Forsyth Technical Institute; Fairley Cameron, Gaston College; Harold Rhodes, Guilford Technical Institute; James Bain, Lenoir Community College; Jim Fulcher, Pitt Technical Institute; Jim Bass, Robeson Technical Institute; Doug Coone, Rockingham Community College and Ken Hughes, K & S Tool and Manufacturing Company.

Acknowledgement is extended to the industrial representatives who assisted in the task survey. Employers from all over the state were selected to participate in the validation process. Their response by letter and through attendance at meetings provided valuable input in determining the final outcomes of the curriculum.

Thanks are due to those instructors not formally on the committee who reviewed and critiqued the materials at various stages during the development process. Their recommendations and encouragement were helpful in proceeding through the project.

Acknowledgement and sincere thanks are extended to high school machine shop teachers in the state who participated in determining where skills should be taught by educational level. Their constant cooperation will continue to improve machinist education and training.

Special appreciation is expressed to Ken Hughes who served as a consultant in compiling and completing the curriculum manual. His knowledge of the machinist curriculum, the machinist programs in various institutions, the competency project, educational methodology, and industry practices and needs was invaluable in the review and preparation of materials for the final document.

Thanks are due to Lori Grippo, Brenda Crowder, Linda Horton and Beverly Cable for secretarial services, to Peggy Ball and Linda Horton for editorial services and to Bill Pugh who designed the cover.

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Chapter I

INTRODUCTION

The machinist curriculum has been offered by North Carolina technical institutes and community colleges since their establishment as industrial education centers in 1958. This curriculum has been offered to meet the growing needs in the state for personnel trained in the machine shop fields.

With more sophisticated equipment introduced into local industries and with a more transient labor force, the Association of Instructors of Machine Shop (AIMS) felt a more uniform curriculum was needed throughout the state. In conjunction with the Department of Community Colleges, local institutions, and local industries, a committee was formed in mid-1976 to determine educational needs for training persons in machinist skills for industries in the state. It was at this same time that the Department of Community Colleges was beginning a statewide curriculum development project to develop compentency-based curriculums. The result was that the machinist curriculum became one of the curriculums to be included in the competency project.

Presentations were made at statewide meetings of machinist instructors to explain the competency project and to solicit their assistance. A curriculum committee of instructors was formed to assist in the project. The committee compiled information to make a job need survey and a task survey of industry. The curriculum committee reviewed all responses from the two surveys to determine the job levels and tasks required. From the results of these surveys the committee proposed that it review the existing state curriculum guide, recommend modifications to update the content, define performance levels within the curriculum, propose possible early skills development approachs, define admission criteria, and work with industry to outline exit levels related to types of tasks preformed.

The committee's activities resulted in an updated curriculum that includes:

1. Curriculum guides and course outlines for the four quarter machinist curriculum (V032).

2. Exit performance levels within the machinist curriculum compatible with Dictionary of Occupational Titles (D.O.T.) job categories.

3. Suggested lab experiences and instructional resources for the instructor.

4. Tasks and competencies by job level and by quarter.

5. Optional electives in the fourth quarter.

This manual provides information developed to support institutions wishing to implement the revised curriculum. Emphasis of the manual is on the software needed to implement the revisions. In addition to curriculum guides, course outlines and equipment lists, the manual

includes job descriptions, job competencies, and performance objectives for the machine shop curriculum. This information can be used in helping focus the instructional activities of the curriculum. It can also be used to determine both the advanced placement of students with prior experience or education in the machine shop field and the employable skills of early leavers.

The machinist curriculum job related materials have been reviewed and discussed in several different statewide meetings of machine shop instructors with favorable concensus at all meetings. The concensus of these comments is included in the manual.

Program Implementation

This manual is available as an aid for institutions wishing to update the machinist program as well as for the institution initiating a curriculum to train persons in the machine trades. Items provided in the manual include a suggested curriculum by quarter, course descriptions, task analyses, job competencies, course outlines with instructional objectives and suggested learning activities, industry and institutional survey information and equipment lists.

The information provided in the manual lends itself to be used in various ways. Some instructors on the curriculum committee began using parts of the material as it was being developed, with each finding a different way to apply it to a particular educational situation. It is recommended that institutions adopt the curriculum guide upon the recommendation of their local advisory committee. Instructional materials are provided to assist the instructor in teaching the program described by the curriculum guide.

The curriculum courses included in the manual supersede the earlier curriculum courses by the same numbers and titles. No official action, other than receipt of a letter of intent by the Department of Community Colleges, is necessary at the state level for the institution to modify its existing curriculum to the new format.

Curriculum Design

The machinist curriculum is designed as a vocational program with emphasis on the development of specific skills related to employment in the machine trades. Content has been arranged to provide for the development of increasing levels of skills as the student progresses in the program. General shop skills are taught in the first quarter to familiarize the student with bench work and the operation of machines. During the second quarter the student should become proficient in the operation of most machines. The third quarter concentrates more on machine set-up and operation skills. The fourth quarter covers specialized machining skills that the student will need in working as a machinist.

Related courses have been included in the curriculum to support the knowledge and skills required by job level as indicated by employers. In addition to communication skills, courses in blueprint reading, math, metallurgy, welding, and applied science are included.

Levels of performance have been described with job titles, performance objectives, competency statements and evaluative criteria to help identify educational and job entry and exit points. Job descriptions have been provided. These statements can be used to describe the educational experiences recommended for students prior to completion of levels within the curriculum. It is recommended that these statements be reviewed and refined by the local advisory committee to assist the institution in meeting local manpower needs. Further assistance might be provided by the local advisory committee in reviewing tasks, competencies, and instructional and performance objectives to determine if

all identified skills should be taught as described.

Instructional materials provided in the manual include course outlines, task lists (by job and educational level), task analyses, competencies and evaluative criteria, texts and references, and audio-visual materials. Course outlines include instructional objectives, content outline, activity experiences, performance objectives and suggested texts. Task lists are organized by content areas and are cross referenced by suggested job and educational levels. Task analyses include skill, knowledge, attitude motivators, competencies and evaluative criteria. Texts and references include standard textbooks, industrial materials and curriculum materials from other sources. Audio-visual materials listed are primarily films, filmstrips and slides available from selected sources and currently used by some instructors in the state.

Faculty

The effectiveness of any program depends largely upon the competence and enthusiasm of the instructional staff. The specialized nature of the machinist program and high degree of machine shop skills required necsitate that the instructor have industrial experience as a machinist, tool and die maker, maintenance machinist, or machine shop foreman. Other related vocational experience should also be considered. The number of faculty and qualifications for each faculty member should be sufficient to implement the curriculum design and accomplish the objective(s) of the program.

The teaching load of the machine shop instructor should be consistent with the teaching load of other instructors in other curriculum areas in the institution. Factors to be considered in making load determination should include: (1) class contact hours, (2) number of preparations, (3) student loads, (4) committee assignments, (5) departmental responsibilities and (6) other special duties. A full time load is usually considered to be from 16 to 25 contact hours per week. The number of students could vary from 12 to 25 depending upon the equipment available with a recommended average class size of 15 full-time students. The machine shop instructor should also be responsible for maintaining liaison with industry through advisory committee meetings, personal contacts, and other suitable methods.

As indicated earlier, the successful operation of the machine shop program or any program within an institution depends to a great extent on the selection, continuous development, and satisfactory retention of faculty members. The faculty should be able to carry out the objectives of the machine shop program and to plan, implement and evaluate learning experiences essential to the program. The faculty should also be able to counsel students, work with individuals and organizations within the community, and through continuing education and/or professional organizations be aware of the changes developing in the machine shop trades.

Facilities

The community college or technical institute is responsible for providing adequate and attractive facilities which are appropriately located for instruction.

For the machinist program, at least one laboratory-classroom with equipment for demonstration and laboratory practice is needed. The laboratory should consist of a minimum of 2,000 square feet of space. The laboratory should be properly lighted, ventilated, heated, air-conditioned and fire proofed. Electrical capacities should be a minimum of 600 AMP (single phase and three phase) from the main source, with proper disconnects at each piece of equipment. Adequate facilities should be provided to safely handle and store chemicals, steels and gases used for instructional purposes. A structurally sound floor adequate to support the weight of the metalworking machinery is required. Additional laboratory space may be needed if simulation is used in the program. The room(s) should be available for student practice at times other than formal laboratory periods.

The number and size of classrooms will depend upon student enrollment, whether or not the classrooms will be used for students in other programs, curriculum design, and methods and media utilized in instruction. Classrooms should be properly lighted, ventilated, heated, air-conditioned and acoustic-proof. Chalkboards and electrical outlets should be located for convenience in audiovisual communication. The classroom should also be equipped with blackout shades or their equivalent for convenience in using audiovisual equipment.

Equipment

The amount and kind of equipment needed for the machine shop program will depend on the instructional process utilized by each instructor and could vary widely from one service area to another. Basic machine shop equipment has been provided to suggest equipment for the institution initiating the machinist curriculum.

Textbooks, References, and Visual Aids

Textbooks, references and visual aids for teaching any subject area must be reviewed constantly and updated or supplemented based on new knowledge in the field and the results of research in teaching methods and developing concepts.

The textbooks, references and visual aids for the suggested machine shop program have been carefully reviewed and selected by writers of the course outlines. From the lists presented, it should be possible to select materials that are appropriate for each institution with the understanding that unlisted materials may also be appropriate.

From these lists, the instructor should select materials that meet stated teaching objectives and should carefully preview and study materials before they are used.

Preparation of any course in the curriculum requires the instructor to become familiar with texts and references in the course outlines and with others that may be available. By using these techniques the instructor will then be able to select materials that best meet the particular needs of the student and that will best promote an interesting, high-level technical presentation to the student.

Library

Part of the strength of any program is indicated by the quality of its library. Characteristics of a quality library include qualifications of the librarian; the facilities; the quality, quantity and relevancy of content; and the staffing and organization. Library facilities should be readily accessible to both full-time and part-time students and faculty not only during instructional hours but for hours beyond regular instructional hours. The library should contain up-to-date books, periodicals and other reference materials related to the machine shop program.

Machine shop instructors and students should be involved in selecting materials for the library and/or approving reference materials for machine shop related courses.

Students should learn to use the library; therefore, instruction should involve the students in library work. This would develop the habit of using the library as a learning tool and help foster a professional attitude that regards libraries as a resource for information on new developments in the machine trades.

Professional Associations

Machine shop associations are an important source of instructional materials and provide other benefits for faculty members and students. Such associations provide information on publications, reports, new concepts, processes, techniques and equipment available in the machine shop trade.

These associations can also provide support in investigating the need for a program, in promoting the program, in providing work experience for students and in placement of graduates.

The associations may also supply resource people to speak to classes, to host student groups on field trips or for individual student projects.

Instructors should be encouraged to work closely with the associations and to become active or ad hoc members if possible. Membership will enable them to learn quickly of developments in the industry and to become acquainted with persons in the community who are most active in the field.

Early in their studies, students should become aware of these associations and the resources they offer. They should also be encouraged to join those associations which offer affiliate memberships.

Chapter II

COMPENTENCY-BASED CURRICULUM DEVELOPMENT PROJECT

In July 1976, the Program Development Section of the Department of Community Colleges initiated a project to develop compentency-based curriculums on a statewide basis. This project was proposed to further the following purposes: (1) to describe the desired outcomes of occupational programs, (2) to provide guidance for increased consistency among programs, and (3) to provide mechanisms for improved articulation with high school occupational programs. In order to accomplish these purposes the project was designed to solicit the recommendations of instructors in community colleges and technical institutes, employers, and high school occupational teachers to determine the compentencies required by employers for successful employment on the job. Information developed in the project was to be utilized to design curriculums with multi-entry, multi-exit levels based on job skill requirements. Materials to be developed for each curriculum included (1) a validated list of tasks performed by employees in a given job, (2) competencies which are required to perform successfully in the job, (3) curriculum guidelines, and (4) curriculum materials based on the guidelines to assist educational personnel in providing quality occupational education programs.

Machinist Curriculum

The machinist curriculum was chosen as one of the curriculums to be included in the competency-based curriculum project since machinist instructors were already considering a review of the existing curriculum. The existence of a large number of machinist programs in two year institutions, an active instructor's association, and a number of high school occupational programs in machine shop also encouraged the selection of the curriculum to be included in the project. The procedure used in conducting the competency-based curriculum project for the machinist curriculum included (1) appointing curriculum committees (Appendix A and B), (2) initiating a resource search (Appendix D), (3) identifying and validating training needs of employers (Appendix C and F), (4) listing and validating tasks by job levels (Appendix G), (5) analyzing tasks (Appendix K), (6) writing competencies and evaluative criteria (Appendix J), (7) specifying tasks by educational level (Appendix I), (8) writing course content to include instructional objectives (Chapter IV), (9) developing course descriptions and the curriculum guide (Chapter IV), and (10) providing information for instructors on supportive instructional materials (Chapter VI). The results of the project are compiled in this manual.

Organization of Curriculum Committees

Each phase of this project was designed to assure maximum involvement of instructors and employers. In order to assure involvement, the organization plan called for a curriculum committee and a curriculum advisory committee.

The Machinist Curriculum Committee was composed of instructors from the Community College System. The committee was a working committee and was responsible for preparing all materials including the career opportunity survey, task analysis, competencies, and curriculum materials.

The Machinist Curriculum Advisory Committee was composed of members of the curriculum committee, employers, and teachers from high school machinist programs. This committee provided advise and counsel on specific questions concerning employment, competency levels, articulation with high school programs, survey data, task analyses, and curriculum.

Resource Search

A resource search was implemented to locate educational materials available that could be used to assist in this project. Curriculum laboratories in other states, ERIC, the U. S. Army, technical societies, textbook publishers, and others were contacted for copies of materials available on machine shop instruction. Many of these contacts proved fruitful in providing good instructional materials, but there was very little material available on competencies or tasks for the machinist curriculum. This meant that a large portion of the curriculum materials had to be written by the committee.

Career Opportunity Survey

A career opportunity survey was conducted to determine machine shop jobs available in North Carolina. Selected industries throughout the community college and technical institute service area were surveyed. Industry contact persons were identified with the help of instructors. Each instructor on the committee was asked to identify at least five employers in his service area that would participate in the project.

Dictionary of Occupational Titles (DOT) titles for selected machine shop occupations were listed in the career opportunity survey. There were 32 job titles listed and space left to add more. Respondents were asked to indicate if they felt a need for these jobs to exist in North Carolina and were asked to add other titles in which they presently employed persons. (Refer to Appendix F Career Opportunity Survey and Response).

There were 91 career opportunity forms mailed and 45 forms returned for a 50 percent response. (Results of the survey are indicated in Appendix G Machine Trades Tasks: Response from Industry). The task survey validated the present need for machine shop personnel in numerous job categories. The career opportunities identified were rearranged into major job categories according to the level of skills required. These category and job titles are shown in the table below. Job descriptions for a typical job in each job category are listed in Chapter III. With the continuing relocation and expansion of industry in North Carolina, there is an ever increasing need for machine shop personnel.

MACHINE SHOP CAREER OPPORTUNITIES

Identified by Survey

Category	D.O.T. Number	Job Title
Basic	609.685-018	MACHINE OPERATOR
	609.685-018	Production-Machine Operator
	609.662-010	Numerical-Control-Machine Operator
		Quality-Control Technician
Intermediate	600.380-018	MACHINE SET-UP OPERATOR
	601.280-054	Tool-Machine Set-Up Operator
	604.380-026	Turrent Lathe Set-Up Operator
	609.131-010	Quality Control Foreman
Advanced	600.280-026	MACHINIST APPRENTICE
	601.381-022	Die-Maker Apprentice
	601.280-058	Tool-Maker Apprentice
	601.280-050	Tool-and-Die-Maker Apprentice
Advanced with Experience	600.280-022	MACHINIST
	600.280-042	Maintenance Machinist
	600.131-010	Machine Shop Foreman
	601.281-010	Die-Maker
	601.280-042	Tool-Maker
	601.280-046	Tool-and-Die Maker
Related	603.280-038	Tool-and-Cutter Grinder
	601.130-010	Tool-and-Die Foreman
		Heat Treater

Task List

A list of tasks was compiled by the curriculum committee. This list was organized according to major topics required in the machinist field. Major job categories from the Career Opportunity Survey were cross-referenced with the tasks. The committee then identified which tasks were required for each job category. This information was sent to those employers responding to the first survey (45) and to all institutions offering the curriculum (27) for validation. Twenty-three employers (50%) and nine instructors (33%) responded to this survey. There was a high correlation between the responses of the two groups (Appendix G). Information provided by this survey was used to help structure the tasks by educational level later in the project.

Task Analyses

Tasks were analyzed to determine skills, knowledge, and attitudes necessary to perform each major task. Competencies and evaluative criteria were written to support each major task category. Employers serving on the curriculum advisory committee reviewed the task analyses, competencies and evaluative criteria and made revisions to reflect the needs of industry. This information was used later to help define the content, performance objectives, and instructional objectives of the course outlines. Each task analysis with competencies and evaluative criteria provides a concise reference on the skills, knowledge and performance criteria for major tasks. This information can be used in a variety of ways in the instructional program including use as a teaching guide, evaluation guide, and an outline for designing modular instructional materials.

Specifying Tasks By Educational Level

Tasks were specified by educational level by using the survey data from the task validation phase of the project. The categories of machine operator, machine set-up operator, and machinist were analyzed. Initially, tasks common to all three categories were located in the first quarter; all additional tasks required for the operator were placed in the second quarter; all tasks required for the set-up operator but not already covered by the operator were scheduled in the third quarter; and all tasks required by the machinist not covered by the set-up operator were scheduled in the fourth quarter. This information was then carefully reviewed by the committee and minor rearrangements were made as necessary to provide an educationally sound program. If advanced instruction or additional practice was needed on a particular task, this was indicated for the quarter in which it was recommended. The result was a detailed list of tasks recommended to be taught on a quarter-by-quarter basis to provide progressive levels of skills for students that would parallel specific job levels in the machinist field.

Course Materials

The need for courses for the machinist curriculum was determined from the list of tasks by educational level. After tasks were arranged by quarter, course descriptions were written to define the content to be covered. Where existing course descriptions were satisfactory, these were used. To assist in the development of new course outlines, information was extracted from the task analyses and arranged according to the quarter in which it was to be taught. Instructional objectives, content, activity experiences, performance objectives, and suggested texts and references were included. The resulting outlines provide specifics on the objectives of the course, the content to be taught, materials available to teach each concept, and the desired performance of the learner.

Curriculum Guide

After determining the courses to be taught and the quarter in which they were to be scheduled, the curriculum guide was essentially complete. The guide was reviewed by the committee then distributed to all machinist instructors for discussion. The guide was discussed by instructors at two statewide meetings of the machinists instructors -- the 1978 Community College Conference and the fall 1978 meeting of AIMS. All questions raised by instructors at these meetings were resolved to their satisfaction by committee members, either by explanation or through agreement to changes in the curriculum. Basic changes in the new curriculum are either within course areas, such as the content arrangement of the machine shop courses, or in rearrangements to the curriculum, such as moving a course to a different quarter. These are minor but important changes. They result in a curriculum guide with educational levels that provide for multi-entry and multi-exit performance levels based on job skill requirements. The curriculum was developed with the recommendations of both instructors in the post-secondary and secondary machinist programs and employers in the field. The curriculum guide is in the format of earlier curriculum guides and can be readily implemented as a revised curriculum. The curriculum guide provides a description of the curriculum, general considerations, a suggested curriculum by quarters, and course descriptions.

Supportive Instructional Materials

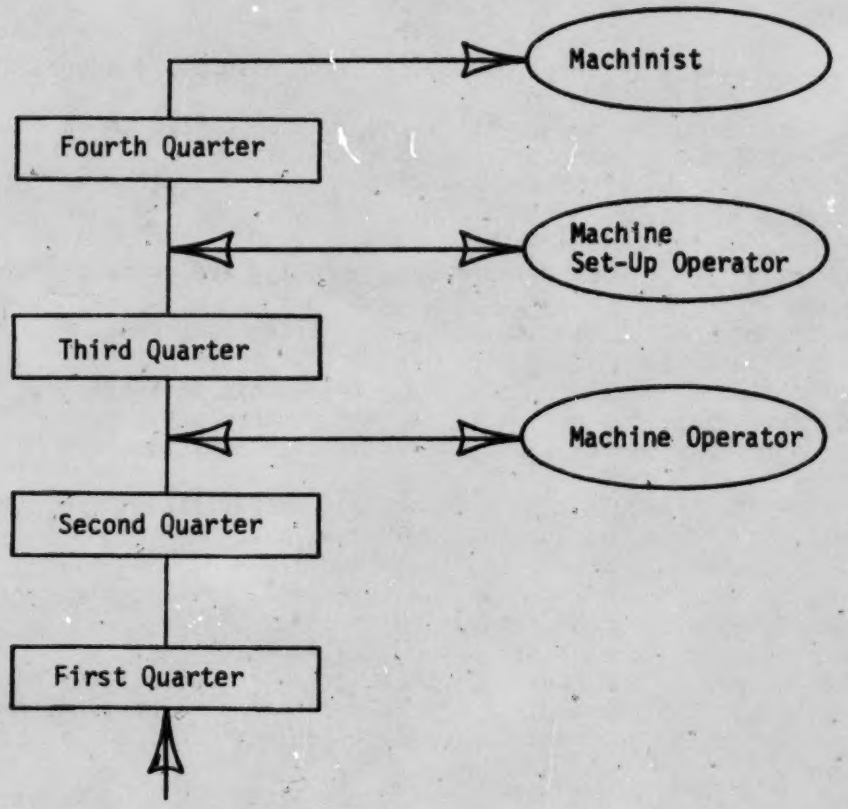
Instructional materials were compiled to assist instructors teaching the machinist curriculum. In addition to the task list, task analyses, course outlines, and curriculum guide, there are lists of resource materials and audiovisual materials from selected sources. These reference and audiovisual materials were located in the process of developing the manual and are included in the curriculum manual as an example of the variety of materials available to supplement the instructional program.

Chapter III

JOB DESCRIPTIONS/JOB COMPETENCIES

Suggested job descriptions and job competencies have been identified for the machinist, machine set-up operator and machine operator. These general statements can be used to assist in describing the types of educational experiences recommended for students at levels intermediate to the completion of the curriculum. More specific job competency statements and job tasks are included elsewhere in the manual. It is recommended that these statements be reviewed by local advisory committees and used to assist the institution in meeting local manpower needs. The following chart suggests typical jobs that could be filled by individuals proceeding through the machinist curriculum.

Sample Job Opportunities
By Educational Level



Machine Operator

Job Descriptions

Tends any of a variety of machine tools, such as lathes, drill presses, milling machines, grinders, or special-purpose machines to machine metal workpieces to specifications on production basis: lifts workpiece manually or with hoist and positions and secures in fixture, or loads automatic feeding device. Starts machine, engages feed, and observes operation. Verifies conformance of machined workpieces to specifications, using instruments, such as preset comparator, fixed gauges, calipers, or micrometer. May move controls to adjust machine. Changes worn cutting tools, using wrenches. May operate bench grinder to sharpen tools. May machine plastics or other nonmetals. May tend machines and equipment other than machine tools, such as welders. May be required to transfer from one type of machine to another as situation demands. May be required to have experience with particular material, product, or size, type, or trade name of machine and be designated accordingly.

Job Competencies

Demonstrate competency in safety practices in all shop procedures and equipment.
Perform layout procedures and identify and use basic hand tools.
Operate all shop power sawing equipment.
Demonstrate ability to set up and operate sensitive, upright and radial drills on simple setups.
Set up and operate the engine lathe.
Operate the pedestal grinder for off hand grinding and grind different style tools.
Set up and operate horizontal and vertical milling machines.
Read blueprints and simple shop sketches.
Perform mathematical operations involving fractions, decimals, addition, subtraction, multiplication, division, and conversions.
Be aware of common types and causes of industrial accidents and how to avoid them.
Use hand tools and measuring tools to achieve proper fits.
Exhibit basic skills in reading and comprehension.
Select saw blade, pitch, speeds and feeds for a given power sawing job.
Select speed, feeds and make set ups on power drills.
Select speeds, feeds and make set ups on a lathe.
Select speeds, feeds and make set ups on milling machines.
Select wheels, speeds, and make set ups on grinders and cut off machines.
Identify geometric figures and solve problems for necessary information.
Interpret blueprint to get mental picture of objects depicted by orthographic projection.
Learn types of materials and their characteristics.
Learn how to communicate with peers and other shop people.

Machine Set-Up Operator

Job Descriptions

Sets up and operates two or more types of machine tools, such as lathes, milling machines, boring machines, and grinders, to machine metal work pieces according to specifications, tooling instructions, and standard charts, applying knowledge of machining methods: reads blueprint or job order for product specifications, such as dimensions and tolerances, and tooling instructions, such as fixtures, feed rates, cutting speeds, depth of cut, and cutting tools to be used. Positions and secures workpiece to hold device, machine table, chuck, centers, or fixture, using clamps and wrenches. Positions and secures tool and workpiece in relation to each other, and to set specified feeds, speeds, and depth of cut. Starts machine, turns handwheel to feed tool to workpiece or vice versa, and engages feed. Turns valve handle to direct flow of coolant or cutting oil against tool and workpiece. Observes operation, and verifies conformance of machined workpiece to specifications, using measuring instruments, such as fixed gauges, calipers, and micrometers. May set up fixtures or feeding device. May operate bench grinder to sharpen tools. May machine nonmetallic materials. May also set up and operate machines and equipment other than machine tools, such as welding machines and flame-cutting equipment. May have experience with particular material, products, precision level or size, type or trade name of machine and be designated accordingly.

Job Competencies (in addition to those of the Machine Operator)

Select, use and care for advanced precision measuring and inspection instruments.
Select and use wheels, feeds, speeds, and coolants for abrasive sawing.
Calculate feed rates and use feed stops for all tools and accessories normally used in a power fed drill.
Set up and operate lathes to an accuracy of 0.005 TIR on work.
Use milling machine and accessories for advanced and special setups.
Calculate speeds and feeds and be able to use shapers and planers.
Select proper grinding wheels and use grinding machines.
Use heat treating and metallurgical test equipment.
Read assembly drawings, sectional views, and patterns, and calculate missing dimensions and angles on drawings.
Solve right angle triangles using sine tables and Machinery's Handbook.
Understand the role of the supervisor and machinist in the industrial environment.

Machinist

Job Descriptions

Sets up and operates machine tools, and fits and assembles parts to make or repair metal parts, mechanisms, tools, or machines, applying knowledge of mechanics, shop mathematics, metal properties, and layout and machining procedures: studies specifications, such as blueprint, sketch, damaged part, or description of part to be replaced, to determine dimensions and tolerances of piece to be machined, sequence of operations, and tools, materials, machines required. Measures, marks, and scribes dimensions and reference points to lay out stock for machining. Sets up and operates metal removing machines, such as lathe, milling machine, shaper, or grinder, to machine parts to specifications. Verifies conformance of workpiece to specifications, using measuring instruments. Positions and secures workpiece in holding device, such as chuck or collet, or on surface plate or worktable with such devices as vises, wrenches, to fit and assemble parts to assemblies or mechanisms. Verifies dimensions and alinement with measuring instruments, such as micrometers, height gauges, and gauge blocks. May operate mechanism or machine, observe operation, or test with inspection equipment, to diagnose malfunction of machine or to test repaired machine. May perform flame cutting and arc or gas welding operations, when required. May develop specifications from general description and draw or sketch product to be made.

Job Competencies (in addition to those of the Machine Set-Up Operator)

Perform all phases of bench work operations including layout of parts, filing of parts, and polishing to required specifications.
Layout, set up and perform all necessary operations required on a drill press.
Set up and operate lathes using all accessories and attachments, machining to tolerances and finishes specified on blueprints. May perform basic set ups and operate production lathes.
Use dividing head, gearing, angular set ups and perform production operations on milling machines.
Select correct wheels, operate, and perform set ups and finish parts using accessories and attachments on various types of grinders and grind items to print specifications of 0.005 T I R.
Apply physical concepts related to the machinist trade.
Perform basic gas and arc welding and simple wire feed operations.
Use Machinery's Handbook with special attention to gearing, mechanics, trig, and geometry.

Chapter IV

CURRICULUM

The machinist curriculum, course outlines and curriculum standards have been developed by the curriculum committee to assist institutions in revising their existing curriculum or in implementing the machinist curriculum as a new program in the institution. The curriculum was developed with input from employers and instructors from across the state. It reflects current needs as perceived by these individuals.

For the institution revising its machinist curriculum the suggested curriculum guide follows the same format as the earlier curriculum guide. Changes in the suggested curriculum guide are primarily in the organization of content within the curriculum. A course in safety has been added and a second course in applied science removed. An elective course has been included to provide an institutional or student emphasis.

Only complete course outlines for the four specialty machinist courses are included in the manual. For all other courses brief topical outlines are provided. For copies of complete course outlines on the other courses, the institution should contact the Program Development Section, Department of Community Colleges, Education Building, Raleigh, and request the course outline by title and number.

MECHANICAL-MANUFACTURING OCCUPATIONS

MACHINIST

INTRODUCTION

Purpose of Curriculum

This curriculum was prepared to meet the need for trained machinists. Existing industries in North Carolina and new industries moving into the state express the need for skilled craftsmen who have the background, knowledge, and potential to advance in the machine trades. This curriculum is designed to prepare the individual, through theory and practice of various machining operations and related courses, to obtain paid employment in the metal machining occupations.

Job Description

The machinist is a skilled metal worker who shapes metal parts by using machine tools and hand tools. His training and experience enable him to plan and carry through all the operations needed in turning out a machined product and to switch readily from one kind of product to another. A machinist is able to select the proper tools and material required for each job and to plan the cutting and finishing operations in their proper order so that he can complete the finished work according to blueprint or written specifications. He makes standard shop computations relating to dimensions of work, tooling, feeds, and speeds of machining. He often uses precision measuring instruments such as micrometers and gauges to measure the accuracy of his work to thousandths of an inch.

This skilled worker must be able to set up and operate most types of machine tools. The machinist also must know the composition of metals so that he can heat and quench cutting tools and parts to improve machinability. His knowledge enables him to turn a block of metal into an intricate, precise part.

Career Opportunities

The machinist may start in one or more of the following areas: machine operator, machine setup operator, machinist apprentice, tool/die/mold apprentice, maintenance helper, machine tool technician, machine and tool salesman, or quality control technician. Advanced jobs in the field include: production foreman, tool/die/mold maker, general machinist, maintenance machinist, tape control programmer, or self-employment in one of the above fields.

General Considerations

The machinist curriculum is designed to be taught at a vocational level with emphasis on the hands-on operation of metal working equipment. It is structured to provide specific job skills at several points within the one-year program. Possible job opportunities corresponding with the curriculum sequence include:

First quarter - production-machine operator, drill press operator, lathe operator, cutoff saw operator, layout helper, and tool crib attendant

Second quarter- machine operator (general), milling machine operator, quality control technician

Third quarter - machine set-up operator, shaper and planer operator, drill press/lathe/mill/saw set-up operator, and cylindrical grinder operator

Fourth quarter- machinist apprentice, tool/die/mold maker apprentice, machinist, programmer, tool and cutter grinder, surface grinder set-up operator, tool and cutter salesman, heat treater

Content has been arranged to provide experiences appropriate for entry to these jobs. Courses in math, blueprint reading, welding and other related subjects are recommended in specific quarters of the curriculum to support the development of skills at the performance levels identified.

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MACHINIST

SUGGESTED CURRICULUM BY QUARTERS

Course Title	Hours Per Week		Quarter Hours Credit
FIRST QUARTER	**Class**	**Lab**	
MEC 1101 Machine Shop Theory and Practice	3	12	7
MAT 1101 Fundamentals of Mathematics	5	0	5
DFT 1104 Blueprint Reading	0	3	1
ENG 1101 Reading Improvement	2	0	2
ISC 1101 Industrial Safety	3	0	3
	13	15	18
SECOND QUARTER			
MEC 1102 Machine Shop Theory and Practice	3	12	7
MAT 1103 Geometry (or an applied math course covering these concepts)	3	0	3
DFT 1105 Blueprint Reading: Mechanical	1	2	2
MEC 1118 Introduction to Metals	3	2	4
ENG 1102 Communication Skills	3	0	3
	13	16	19
THIRD QUARTER			
MEC 1103 Machine Shop Theory and Practice	3	12	7
MAT 1104 Trigonometry (or an applied math course covering these concepts)	3	0	3
DFT 1106 Blueprint Reading: Mechanical	1	2	2
MEC 1119 Applied Metallurgy	2	3	3
PSY 1101 Human Relations	3	0	3
	12	17	18
FOURTH QUARTER			
MEC 1104 Machine Shop Theory and Practice	3	12	7
MAT 1123 Machinist Mathematics	3	0	3
WLD 1103 Welding	0	3	1
PHY 1111 Applied Science	3	2	4
Elective	3	0	3
	12	17	18

Total Quarter Hours in Courses	70
Electives	3
Total	73

MACHINIST

COURSE DESCRIPTIONS BY QUARTER

FIRST QUARTER	Hours Per Week Class	Lab	Quarter Hours Credit
MEC 1101 Machine Shop Theory and Practice	3	12	7

An introduction to the metalworking trade as it relates to machining operations. The student will be oriented to the machine shop, safety, basic hand tools, and shop measuring instruments. Operations on engine lathes, drilling machines, metal cutting saws, milling machines, and bench grinders will also be covered.
Prerequisite: None.

MAT 1101 Fundamentals of Mathematics	5	0	5

Practical number theory. Analysis of basic operations: addition, subtraction, multiplication, and division. Fractions, decimals, powers and roots, percentages, ratio and proportion. Plane and solid geometric figures used in industry; measurement of surfaces and volumes. Introduction to algebra used in trades. Practice in depth.
Prerequisite: None.

DFT 1104 Blueprint Reading	0	3	1

Interpretation and reading of blueprints. Information on the basic principals of the blueprint; lines, views, dimensioning procedures and notes.
Prerequisite: None.

ENG 1101 Reading Improvement	2	(	2

Designed to improve the student's ability to read rapidly and accurately. Class drill is used to broaden the span of recognition, to increase eye coordination and word group recognition and to train for comprehension in larger units. Reading weaknesses are analyzed for improvement and principles of vocabulary are stressed.
Prerequisite: None.

ISC 1101 Industrial Safety	3	0	3

A study of the development of Industrial Safety; accident occurrence and prevention; analysis of accident causes and costs; basic factors of accident control; safety education and training; accident reporting and records; employer and employee responsibility; safety organizations; first aid; mechanical safeguards; personal protective equipment use; materials handling; fire prevention and protection; safety codes; and accident statistics.
Prerequisite: None.

SECOND QUARTER

MEC 1102 Machine Shop Theory and Practice 3 12 7

An introduction to the assembly of parts, fits, hand broachs, screw and tap extractors, set-up equipment, inspection tools, gauges, buffing and polishing, and surface grinders. Continued instruction in the use of precision measuring tools, selection of speeds and feeds, reciprocating and continuous band cut-off saws, contour band saws, lathes, power drills, and milling machines.
Prerequisite: MEC 1101.

MAT 1103 Geometry 3 0 3

Fundamental properties and definitions; plane and solid geometric figures; selected general theorems; geometric construction of lines, angles and plane figures; dihedral angles; areas of plane figures; volumes of solids. Geometric principles are applied to shop operations.
Prerequisite: None.

DFT 1105 Blueprint Reading; Mechanical 1 2 2

Further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.
Prerequisite: DFT 1104.

MEC 1118 Introduction to Metals 3 2 4

This course is designed to familiarize the student with the different properties of ferrous and non-ferrous metals. It provides a background for understanding the physical changes and chemical metallurgy of producing metals. Explains the material designation system, classifications of steels, trade names and cross reference information for comparable materials. Common shop terms used in treatment of metals will be explained.
Prerequisite: None.

ENG 1102 Communication Skills 3 0 3

Designed to promote effective communication through correct language usage in speaking and writing.
Prerequisite: ENG 1101.

THIRD QUARTER

MEC 1103 Machine Shop Theory and Practice 3 12 7

Additional instruction and practice in the use of precision measuring tools, milling machines, and surface grinders. Practice in setting up and operating machine tools including the selection and use of work holding devices, feeds and speeds, special heads and tables, cutting tools, and coolants. Instruction and practice in the use of power feed drills and abrasive saws.
Prerequisite: MEC 1102.

MAT 1104 Trigonometry 3 0 3

Trigonometric ratios; solving problems with right triangles, using tables, and interpolating; solution of oblique triangles using law of sines and law of cosines; graphs of the trigonometric functions; inverse functions, trigonometric equations. All topics are applied to practical problems.
Prerequisite: MAT 1103.

DFT 1106 Blueprint Reading: Mechanical 1 2 2

Advanced blueprint reading and sketching as related to detail and assembly drawings used in machine shops. The interpretation of drawings of complex parts and mechanisms for features of fabrication, construction and assembly.
Prerequisite: DFT 1105.

MEC 1119 Applied Metallurgy 2 3 3

Covers practical metallurgy theory and practice in the treatment of ferrous and non-ferrous metals. Actual practice of heat treatment will be performed on sample materials with emphasis on low and high carbon steels. Relationships between part design and heat treatment will be applied. Testing equipment for verification of correct treatment will be used.
Prerequisite: MEC 1118.

PSY 1101 Human Relations 3 0 3

A study of basic principles of human behavior. The problems of the individual are studied in relation to society, group membership, and relationships within the work situation.
Prerequisite: None.

FOURTH QUARTER

MEC 1104 Machine Shop Theory and Practice 3 12 7

The student will work to required tolerances setting up and operating machine tools. An introduction to turret lathes, advanced milling machine operations, special machining operations, and special machines. Also covered will be grinding specific surfaces using hand, surface and cylinderical grinders, and lapping and honing parts to specified tolerances.

MAT 1123 Machinist Mathematics 3 0 3

Introduces gear ratio, lead screw and indexing problems with emphasis on application to the machine shop. Practical applications and problems furnish the trainee with experience in geometric propositions and trigonometric relations to shop problems; concludes with an introduction to compound angle problems.
Prerequisite: MAT 1104.

WLD 1103 Welding 0 3 1

The various processes used for joining materials by welding are discussed. Lecture demonstrations and practice cover the oxyacetylene and arc welding processes, filler metals used, gases, currents, weldability of metals. Instruction is given in the set-up and safe operation of oxyacetylene welding apparatus. Students prepare joints by both hand and machine cutting with the oxyacetylene torch.
Prerequisite: None.

PHY 1111 Applied Science 3 2 4

An introduction to physical principles and their application in industry. Topics in this course will support the particular curriculum in which the course is offered and will be selected from the following: measurement, force, motion, work, energy, power, solids, liquids, gases, heat, thermometry, electrical principles, properties of matter, sound, and light.
Prerequisite: None.

ELECTIVES

The following is a list of electives for this curriculum from which the institution may select courses to complete the program of study. The institution has the prerogative to develop new courses for the electives or modify courses from the suggested list to fulfill local objectives. It is suggested, however, that technical courses be related to the major area of study. These courses should not change or alter the major objectives of the program nor create a false impression of proficiency in an area either related or foreign to the major.

Elective courses selected must be associate degree courses, or new courses should be developed at a comparable level. The institution may elect to require certain electives or may let the student select an appropriate elective.

BUS 1105 Industrial Organizations	3	0	3

Methods, techniques, and practices of modern management in planning, organizing and controlling operations of a manufacturing concern. Introduction to the competitive system and the factors constituting product cost.
Prerequisite: None.

MEC 1117 Machine Repair	2	3	3

This course is designed to acquaint the student with the movable parts of machine tools, the basic methods of joining these parts together, adjustments necessary to obtain satisfactory service, removal and reinstallation of worn parts, uses of lubricants as applied to machine tools, safety precautions as directed by OSHA.
Prerequisite: None.

BUS 1103 Small Business Operations	3	0	3

An introduction to the business world, problems of small business operation, basic business law, business forms and records, financial problems, ordering and inventorying, layout of equipment and offices, methods of improving business, and employer-employee relations.
Prerequisite: None

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COURSE OUTLINE

MEC 1101 MACHINE SHOP THEORY AND PRACTICE

Developed By

Machinist Competency Curriculum Committee

May 1979

PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEC 1101 - MACHINE SHOP THEORY AND PRACTICE

DESCRIPTION OF COURSE:

An introduction to the metalworking trade as it relates to machining operations. The student will be oriented to the machine shop, safety, basic hand tools, and shop measuring instruments. Operations on engine lathes, drilling machines, metal cutting saws, milling machines, and bench grinders will also be covered.
Prerequisite: None.
Course Hours Per Week: Class, 3; Laboratory, 12

Quarter Hours Credit: 7

Prerequisite: None

Course Objectives: Specific objectives are included in the outline of instruction.

Course Outcomes: The machinist curriculum is structured to provide employable skills early in the curriculum and progressing in level of difficulty according to job levels. This course is intended to prepare the student with basic skills common to the machine operator, set-up operator, and the machinist. The course should focus on developing primary skills such as first aid, working with hand tools and measuring instruments, and operating various metalworking machines.

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
	ORIENTATION & SAFETY			
1.1	ORIENTATION			
1.11	The student will locate and switch on and off master power switch	I. Location of master switch	Facility tour conducted by instructor AV 1-2	I. Switch on and off master power switch
1.12	Evacuate the shop or classroom using proper route	II. All exits (a) Route to exits (b) Aisle markings	Facility tour conducted by instructor	II. Drill evacuation route
1.2	SAFETY			
1.21	Locate and identify the proper type and use of fire extinguisher	I. Fire extinguisher (a) Location (b) Types (c) Uses	Facility tour conducted by instructor	I. Use fire extinguisher
1.22	Clean, adjust and use proper safety glasses	II. Safety glasses and goggles (a) Types (b) Cleaning methods (c) Adjustments	Demonstration by instructor	II. Clean and adjust safety glasses and goggles for use
1.23	Abide by all safety rules and regulations at all times	III. Safety rules and regulations	Safety handout sheet by instructor ①Read pp. 1-8 AV 4	III. Follow safety rules and regulations in the shop
1.3	FIRST AID			
1.31	Demonstrate the knowledge of using correct bandages	I. Bandages (a) Types (b) Application	First aid training by Red Cross or adult education personnel	I. Clean and bandage wound

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
1.32	Demonstrate knowledge and practice of mouth to mouth resuscitation	II. Mouth to mouth resuscitation (a) Reason for (b) Time for (c) Methods	First aid training by Red Cross or adult education personnel	II. Demonstrate how to perform mouth to mouth resuscitation using proper practice equipment
1.33	Demonstrate knowledge of different methods to stop bleeding	III. Tourniquet (a) When to apply	First aid training by Red Cross or adult education personnel	III. Stop bleeding of a wound
1.34	Student will demonstrate knowledge on how and when to apply splint	IV. Splint (a) Types of fracture (b) How to apply	First aid training by Red Cross or adult education personnel	IV. Apply splint in correct manner
1.35	Student will demonstrate knowledge of types of eye wash and how and when to use them	V. Eyes (a) Types of washes (b) How to wash	First aid training by Red Cross or adult education personnel 2 Progress quiz #1	V. Wash out eyes using available equipment
	BENCH WORK			
2.1	HAND TOOLS			
2.11	Student will identify and demonstrate the care, uses, and storage of proper hand tools	I. Basic hand tools (a) Types (b) Care (c) Storage (d) How to use (e) Safe practices	①Read pp. 50-64 AV 3 AV 5 AV 8-15 AV 20-22	I. Select and use basic hand tools
2.2	MEASURING TOOLS			
2.21	Student will identify and demonstrate the proper care, use, and storage of semi-precision measuring tools	I. Semi-precision measuring tools (a) Types (b) Care (c) Storage (d) Use	①Read pp. 9-22 Instructor demonstration AV 16 AV 30-33 AV 240 ②Progress quiz #2	I. Select and use semi-precision tools

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
2.22	Student will identify and demonstrate the proper care, use and storage of precision measuring tools	II. Precision measuring (a) Types (b) Care (c) Storage (d) Use	①Read pp. 22-25, 27-49 ②Progress quiz #4 Instructor demonstration AV 27 AV 37-40 AV 44-61	II. Select and use precision tools
2.23	Student will identify and demonstrate the proper care, use, and storage of metric measuring tools	III. Metric measuring tools (a) Types (b) Care (c) Storage (d) Use	①Read pp. 25-27 ④Read pp. 2407-2440 Instructor demonstration ②Progress quiz #3	III. Select and use metric measuring tools
2.3	LAYOUT WORK			
2.31	Student will clean and apply layout dye to work piece	I. Preparing work piece (a) Descaling and deburring (b) Degreasing (c) Types of layout dyes and applications (d) Safety precautions	①Read pp. 75-77 ③Projects - M.S.P.M. Dwgs. No. 1 through 6 AV 17 AV 18 AV 64	I. Prepare work pieces for layout
2.32	Student will identify and demonstrate the proper use, care, and storage of layout tools	II. Layout tools and equipment (a) Types (b) Care (c) How to use (d) Read blueprints (e) Math	①Read pp. 77-85 AV 26-36	II. Select and use layout tools and equipment
2.33	Student will layout work piece using proper tools and techniques	III. Layout work piece (a) Drawing interpretation	①Read pp. 86-87 AV 41-43 AV 68	III. Layout work piece

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
2.33 (cont.)		(b) Application of layout fluid (c) Selection of reference surface (d) Precautions		
2.34	Student will check his layout from the blueprint using his layout tools	IV. Check layout (a) Measurement (b) Use of layout tools and equipment	AV 41-43 ②Progress quiz #7	IV. Check layout on work piece
2.4	HAND CUTTING TOOLS			
2.41	Student will thread work-piece using proper tools and techniques	I. Basic hand threading tools (a) Types (b) Care (c) Storage (d) How to use	①Read pp. 64-71 ③Projects - M.S.P.M. Dwg. #14 AV 23 AV 24 AV 65-66	I. Select and use threading tools
2.42	Student will ream work-piece using proper tools and techniques	II. Basic hand reamers (a) Types (b) Care (c) Storage (d) How to use	①Read page 71 ④Read pp. 1634-1635 AV 25	II. Select and use hand reamers
2.43	Student will chip work-piece using proper tools and techniques	III. Basic chipping and gouging tools (a) Types (b) Care (c) Storage (d) How to use	①Read pp. 58-61 AV 63	III. Select and use chipping and gouging tools
2.44	Student will file work-piece using proper tools and techniques	IV. Basic files and scrapers (a) Types (b) Care	①Read pp. 50-58 ③Project - M.S.P.M. Dwgs. # 1 through 3 ④Read pp. 1940-1944	IV. Select and use of files and scrapers

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
2.44 (cont.)		(c) Storage (d) How to use (e) Proper method of holding for best results (f) Use of file card	AV 6 AV 7 AV 20 AV 62 ②Progress quiz #6	
2.6	PORTABLE POWER TOOLS			
2.61	Student will select the proper portable drill and demonstrate the use and care of the tool	I. Hand drills (a) Types (b) Uses and care (c) Speeds (d) Drills and other cutting tools	Instructor demonstration of correct use and safety	I. Select and use hand drill
2.7	SUPPLEMENTAL OPERATIONS			
2.71	Student will polish work piece demonstrating proper selection of materials, uses, and care	I. Hand polisher (a) Types (b) Care and uses (c) Compounds	④Read pp. 2039-2044 AV 19 AV 67	I. Select and use hand polisher
2.74	Student will hand stamp work pieces	II. Stamp (a) Numbering (b) Lettering	Stamp name on projects as completed	II. Hand stamp work pieces (numbering and lettering)
2.75	Student will learn to etch workpiece	III. Etching machine (a) Type (b) Tool point (c) Method of grounding workpiece	Instructor demonstration	III. Etch name on personal article
2.8	INSPECTION			

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
2.81	Student will set up and demonstrate the proper selection, care, and uses of inspection tools and gauges	I. Set up equipment (a) Use (b) Care (c) Types	④Read pp. 1890-1914	I. Set up equipment
2.82	Student will set up and demonstrate the proper selection, care, and uses of inspection tools and gauges	II. Tool and gauges (a) Use (b) Care (c) Types	④Same as 2.81 AV 73-74	II. Select and use inspections tools and gauges
	POWER SAWING			
3.1	RECIPROCATING & CONTINUOUS BAND CUT-OFF SAW			
3.12	Calculate proper cutting speed for cutting materials and maintain feed	I. Feed and speed (a) Type material	①Read pp. 90-91 Instructor demonstration of controls, safety, and use of machine	I. Establish feed and speed
3.13	Choose and use proper work holding tool	II. Clamp workpiece (a) Vise (b) Stock pusher (c) Automatic feed	Same as 3.12	II. Clamp workpiece
3.14	Cut to a line within normal limits (± 1/8)	III. Straight Cuts (a) Speed control (b) Coolant	③Project - M.S.P.M. Dwgs. #4 through 6 AV 70	III. Make straight cuts
3.15	Cut to an angular line within normal limits (± 1/8)	IV. Angular cuts (a) Feed (b) Blade guides	AV 71	IV. Make angular cuts
3.2	CONTOUR BAND SAW			

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TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
3.24	Speed control set to correct cutting speed for workpiece material. Coolant applied where practical. Feed mechanism adjusted to apply correct pressure.	I. Feed and speed (a) Speed control (b) Coolant (c) Feed mechanism	①Read pp. 92-98 Instructor demonstration of controls, safety, and use of machine	I. Select feed and speed
3.25	Cut to a line within (± 1/8)	II. Saw a layout (a) Blade condition (b) Guides (c) Feed rate	①Read pp. 99-100 ③Project - M.S.P.M. Dwg. #2 and 3 AV 72	II. Saw a layout
3.26	Cut to a contour within normal limits (± 1/8)	III. Contour saw (a) Blade width	①Read pp. 100-105 ③Project - M.S.P.M. Dwg. #1 ②Progress quiz #8	III. Contour saw a part
	DRILLING OPERATIONS			
4.1	HAND FEED DRILL			
4.11	Check drill size by use of a drill gauge; determine if drill is high speed steel and properly sharpened. Set proper RPM and feed rate and set stop for the bottom of blind hole.	I. Drills (a) Types and quality of drills (Limited) (b) Identify parts of a drill (c) Sizing methods and systems (Number, letter, fraction & metric) (d) drill gauge (e) Stops (f) Speed & feed	①Read pp. 106-128 and 553-566 ③Projects - M.S.P.M. Dwgs # 1 through 6 Instructor demonstration of controls, safety, and use of machine AV 75-77 AV 79-81 AV 84 AV 87 ②Progress quiz #9	I. Select correct drill and drill a hole
4.12	Set the machine stop to the correct depth of countersink and set the speed of the machine	II. Countersinking (a) Types of countersinks (b) Angle required	①Read page 129 ③Project - M.S.P.M. Dwgs. #1 through 6 & 12 AV 82	II. Select correct countersink and countersink a hole

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
4.12 cont.)	to the proper R P M (Revolutions per minute)	(c) Diameter of hole (d) Speeds (e) Lubricants (f) Stops		
4.13	Set the machine stop to the correct depth of counterbore and set the speed of the machine to the proper R P M	III. Counterboring (a) Types of counterbores (b) Sizing methods (c) Speeds (d) Lubricants (e) Depths (f) Stops	①Read page 130 AV 78 AV 88	III. Select correct counterbore and counterbore a hole
4.14	Locate workpiece hole concentric with reamer. Apply coolant and set the speed of machine to the proper R P M	IV. Reaming (a) Types of reamers (b) Sizing (straight or taper) (c) Speeds (d) Lubricants (e) Coolant (f) Workpiece (g) Stops	①Read pp. 131-147	IV. Select correct reamer and ream a hole
4.15	Tap a hole	V. Tapping (a) Types of taps (b) Thread systems (c) Tap drill sizes (d) Lubricants (e) Tapping attachments (f) Speeds	①Read pp. 148-150 ③Project - M.S.P.M. Dwg. # 12 AV 83 AV 93 ②Progress quiz #10	V. Select correct tap and tap a hole
	LATHES			
5.1	ENGINE LATHE			
5.12	Student will true stock beginning with chalk and using soft hammer,	I. Set up work in universal chuck	①Read pp. 151-179 ③Projects - M.S.P.M. Dwgs. # 10, 11, 13	I. Set up workpiece in universal chuck

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
5.12 (cont.)	completing with indicator to within .005 T I R		Instructor demonstration of controls, safety, and use of machine AV 94-98, AV 111, AV 132, AV 108	
5.14	Same as universal chuck	II. Types of collets	①Same as 5.12 AV 112, AV 97, AV 110	II. Set up workpiece in collets
5.16	Student will select either a dead or live center, lubricate if dead center, place part between centers with lathe dog and face plate. Indicate part from center to dog and reset tail stock to within .001 T I R	III. Working between centers (a) Types of centers (b) Alignment of centers (c) Type of tool (d) Lubricant of centers	①Read pp. 203-210 ③Projects - M.S.P.M. Dwgs. # 10, 11, 13, 18-B AV 124-127	III. Set up workpiece in centers
5.17	Student will set speed and feed using charts or calculations according to type of cutting tool, material and coolant used	IV. Selection of Proper speeds and feeds (a) Type of work-piece material (b) Type of cutting tools (c) Feed and speed tables (d) Locations for feed and speed tables (e) Lubricant	①Read pp. 255 & 567 & 569 AV 120	IV. Select proper speeds and feeds
5.19	Student will face part insuring facing tool is on center, select speed and feed for desired finish and material. Turn part to shoulder using turning tool.	V. Perform turning and facing operations	③Project - M.S.P.M. Dwgs. #16, 18A & B AV 99-100 AV 105	V. Perform turning and facing operations

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TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
5.19 (cont.)	Select speed and feed as to finish desired and material.			
5.110	Student will thread part by turning to size, chamfer and undercut to thread depth. Select proper size cutting tool and grind to correct 60° point and clearance set compound at 29°. Set tool on center line and perpendicular to centerline of lathe using centergage. Select RPM and set change gear box to correct number of threads. Touch point of tool to part and set both graduation dials at 0. Refer to chart or calculate correct thread depth. Make one pass by engaging half nut. Check thread using pitch gauge. Complete thread to depth. Inspect with go-no-go gauge, thread mike, mating part or wires and mike. Use thread cutting oil.	VI. Perform threading operations (a) Thread systems (b) Selection and/or grinding of tool (c) Set up operation of machine (d) Gauging and measuring procedures	①Read pp. 217-236 ③Project - M.S.P.M. Dwgs. #22, 23, 26 AV 107 AV 129-130 AV 148-151	VI. Perform threading operations
5.112	Student will center drill part and drill 1/64 under reamer size ensuring reamer is run at 1/5 less speed than drilling R P M (Drilling RPM is $\frac{CFPm \times 4}{OD \text{ of drill}}$)	VII. Drilling and reaming principles (a) Types and sizes (b) Feeds and speeds	①Read pp. 245-246 AV 101 AV 115 AV 119	VII. Perform drilling and reaming operations

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
5.115	Student will chamfer part using compound set at correct angle and tool set at correct angle. Use protractor to check angle and (2) steel rules to measure width of chamfer.	VIII. Chamfering principles (a) Proper setup (b) Speeds and feeds (c) Lubricant (d) Measurement	①Read page 210 AV 121	VIII. Perform chamfering operation
5.116	Student will knurl part by setting tool on center line. Set perpendicular to centerline and select pitch of knurls. Operate lathe at low speed or back gear and higher feed rate.	IX. Knurling principles (a) Types of knurls (b) Patterns and pitches (c) Speed and feed (d) Lubricant	①Read pp. 211-213 ③Project - M.S.P.M. Dwgs. # 10, 11, 13 22, 23, 24, 25 ④Read pp. 1841-1845 AV 118 AV 122	IX. Perform knurling operations
	MILLING AND SIMILAR MACHINING OPERATIONS			
6.1	MILLING MACHINES			
6.11	The student will operate various controls and select cutters for different jobs, insuring cutters are free of foreign materials, nicks, and burrs. Hubbs, spacers, and keys and arbors selected. Cutter check for proper rotation.	I. Milling machines and cutters (a) Types (b) Sizes (c) Accessories (d) Use and handling (e) Lubrication (f) Storage	①Read pp. 284-292 AV 156-158 AV 160 AV 170 AV 172	I. Select correct equipment and mount on machine and properly store equipment after use

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES	PERFORMANCE OBJECTIVES
6.13	The student will select the proper cutters, speeds, feeds and use safe practices to perform the type of milling of flat surfaces, according to type materials and coolants used. Use prints and inspect part as to specification.	II. Milling flat surfaces (a) Basic milling principles (b) Conventional milling procedures (c) Climb milling procedures (d) Materials (e) Cutter selections (f) Feeds and speeds (g) Lubricant (h) Safe practice	①Read pp. 279-284 ③Projects #4,5,6,11,23 AV 161-163 AV 175-177	II. Mill a flat surface, face, side and radius
	ABRASIVE MACHINING			
8.6	BENCH AND PEDESTAL GRINDING			
8.62	Set work rests on center of wheel and dress face of wheel true and sharp	I. Diamond dresser Crush dresser	Instructor demonstration of controls, safety, and use of machine AV 188 AV 191	I. Dress and true wheel
8.63	Cut off master switch, adjust work rests to horizontal center line of grind wheel and a maximum of 1/8" from wheel face.	II. Master switch Hand tools	Same as 8.92 AV 190	II. Set workrest and spark arrestor properly
8.64	Select a dull drill and sharpen by freehand to cut a hole on size with correct finish.	I. Correct grid (a) Rake angle (b) Point angle and length (c) Drill gauge (d) Dead center (or web)	①Read p. 124 ④Read pp. 1820-1822 AV 192-194	I. Sharpen twist drill by freehand method to cut properly

TASK CODE	INSTRUCTIONAL OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCES*	PERFORMANCE OBJECTIVES
8.65	Grind a tool blank to a layout to maintain the proper tool geometry for match cutting.	III. Tool blank Layout tools Coolant	①Read pp. 180-198 & 573 ④Read pp. 1796-1808 AV 195-197	III. Sharpen a tool bit (freehand)
8.67	Grind hand tools, punches, chisels, and screwdrivers and restore lathe tools to the original shape.	IV. Grinding hand tools	①Refer to pp. 60-80 ③Project - M.S.P.M. Dwg. #11	IV. Sharpen, chisels, punches and screwdrivers
8.68	Mount wire brush, using safety face shield. Clean parts of foreign matter, (rust, burrs, etc.)	V. Wire brush Safety shield	Same as 8.92 ④Read pp. 2039-2042 AV 186 AV 187 AV 189	V. Use wire brush

*Activity Experience Column: Note 1: The following numbers will indicate textbooks included as suggested texts:

1. Machine Shop Operation and Setup - Text
2. Machine Shop Operation and Setup - Workbook
3. Machine Shop Project Manual
4. Machinery's Handbook

Note 2: AV indicates audio-visual numbers which are listed with available source in Chapter VII of the curriculum manual

SUGGESTED TEXTS

1. Machine Shop Operations & Setup
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

2. Machine Shop Operations & Setup Study Guide
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

3. Machine Shop Project Manual
   Program Development
   Department of Community Colleges
   Raleigh, North Carolina - 1977

4. Machinery's Handbook
   Oberg, Jones & Horton
   Industrial Press
   New York - 20th Ed. - 1976

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NOTE - Number beside text agrees with numbering system used in course outline.

OTHER REFERENCES

Technology of Machine Tools
Krar, Oswald, Amand
McGraw-Hill - Gregg Division
New York - 2nd Ed. - 1977

Machinist's Ready Reference
C. Weingartner
Prachen Publication

FUNDAMENTALS OF MATHEMATICS. Practical number theory. Analysis of basic operations: addition, subtraction, multiplication and division. Fractions, decimals, powers and roots, percentages, ratio and proportion. Plane and solid geometric figures used in industry; measurement of surfaces and volumes. Introduction to algebra used in trades. Practice in depth.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	5	0	5

I. Introduction to the set of real numbers and the base - 10

II. Common fractions and decimal fractions

III. Powers and roots

IV. Percentages

V. Rules and formulas

VI. Ratio and proportion

VII. Geometric figures

VIII. Introduction to algebra

SUGGESTED TEXT:

Van Leuven, Edwin P. General Trade Mathematics. New York: McGraw-Hill Book Company, Inc.

SUGGESTED REFERENCES:

Kaltenborn, H. S., Anderson, Samuel A. and Kaltenborn, Helen. Basic Mathematics. New York: The Ronald Press.

Palmer, Claude and Bibb, Samuel F. Practical Mathematics: Parts I and II; Fifth Edition. New York: McGraw-Hill Book Company, Inc.

Wolfe, John H. and Phelps, Everrette R. Practical Shop Mathematics: Vol. I. New York: McGraw-Hill Book Company, Inc.

BLUEPRINT READING, covers interpretation and reading of blueprints. Information on the basic principals of the blueprint; lines, views, dimensioning procedures and notes.

PREREQUISITE: None.

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	0	3	1

I. Introduction to blueprint reading

II. Shape description methods in drawings

III. Visualizing: blueprint to object; object to blueprint

IV. Special views on blueprints

V. Representation of dimensions and finish

SUGGESTED TEXTS:

McCabe, Keith and Farnham. Mechanical Drafting Essentials; Third Edition. Englewood Cliffs: Prentice-Hall, Inc.

Ihne and Streeter. Machine Trades Blueprint Reading; Third Edition. Chicago: American Technical Society.

Olivo, C. Thomas and Payne, Albert V. Basic Blueprint Reading and Sketching. Albany: Delmar Publishers, Inc.

READING IMPROVEMENT is designed to improve the student's ability to read rapidly and accurately. Class drill is used to broaden the span of recognition, to increase eye coordination and word group recognition and to train for comprehension in larger units. Reading weaknesses are analyzed for improvement and principles of vocabulary are stressed.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	2	0	2

I. Introduction

II. Common faults of slow readers, and their correction

III. Broadening the span of recognition

IV. Accuracy of interpreting symbol forms

V. Apprehension and eye-hand coordination

VI. Building word recognition ability

VII. Numbers and letters

VIII. Vocabulary building

IX. Continuing improvement of speed and comprehension

SUGGESTED REFERENCE:

Leedy, P. E. Reading Improvement for Adults. New York: McGraw-Hill Book Company, Inc., 1956.

INDUSTRIAL SAFETY, a study of the development of Industrial Safety; accident occurrence and prevention; analysis of accident causes and costs; basic factors of accident control; safety education and training; accident reporting and records; employer and employee responsibility; safety organizations; first aid; mechanical safeguards; personal protective equipment use; materials handling; fire prevention and protection; safety codes; and accident statistics.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Accident Toll in the United States

II. Basis of industrial accident prevention

III. Basic philosophy of accident occurrence and prevention

IV. Facts and fact finding - accident causes

V. Application of remedial action

VI. Creating and maintaining interest in accident prevention

VII. Safety education and training

VIII. Safety and health standards - rules

IX. Accident records and reports

X. Industrial first aid

XI. Personal protective equipment

XII. Fire prevention and protection

XIII. Handling Materials

XIV. Accident statistics

SUGGESTED TEXTS AND REFERENCES:

Heinrich, H.W. Industrial Accident Prevention, New York: McGraw Hill Book Company, 1959.

SUGGESTED TEXTS CONTINUED:

Blake, Roland P., Industrial Safety, Third edition, New Jersey: Prentice Hall, Inc., 1963.

The American Red Cross Textbook, Fourth edition.

Safety Precautions for Shore Activities, NAVSO P-2455, Office of Industrial Relations, Department of the Navy, Washington, DC, April 1965.

Industrial Safety Leader's Guide, Series A, Technical Aids Branch, Office of Industrial Resources, International Cooperation Administration, Washington, DC, 1960.

DuPont Library of Industrial Training, Administrative Materials only for Safety Training Observation Program (S-T-O-P) - AA - 522- Price $5.00; All 8 Programmed Instruction courses for Safety Training Observation Program (S-T-O-P) - AA 523 - Price $10.00; For Wage Roll Employees - "Safe Practices Series" - AA 550 thru AA 592 - Price - $1.25 each.

COURSE OUTLINE

MEC 1102 MACHINE SHOP THEORY AND PRACTICE

Developed By

Machinist Competency Curriculum Committee

May 1979

PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEC 1102 - MACHINE SHOP THEORY AND PRACTICE

DESCRIPTION OF COURSE:

An introduction to the assembly of parts, fits, hand broaches, screw and tap extractors, set-up equipment, inspection tools, gauges, buffing and polishing, and surface grinders. Continued instruction in the use of precision measuring tools, selection of speeds and feeds, reciprocating and continuous band cut-off saws, contour band saws, lathes, power drills, and milling machines.

Course Hours Per Week:	Class, 3; Laboratory, 12
Quarter Hours Credit:	7
Prerequisite:	MEC 1101 or equivalent
Course Objectives:	Specific objectives are included in the outline of instruction.
Course Outcomes:	Upon completion of the second quarter of the machinist curriculum, the student should be qualified to perform entry level work as a machine operator. This course should focus on developing intermediate skills in working with hand tools, precision measuring tools, and selected metalworking machines; and basic skills in set-up, inspection, surface grinding, and milling operations.

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE*	PERFORMANCE OBJECTIVES
	BENCH WORK			
2.2	MEASURING TOOLS			
2.22	The student will be instructed on different precision tools such as vernier height gauges and depth gauges	I. Precision measuring tools (a) Types (b) Care (c) Storage (d) Use	④Read pp. 1584-1589 Instructor demonstration	I. Select and use precision tools
2.23	The student will be instructed on different precision tools such as vernier height and depth gauges	II. Metric measuring tools (a) Types (b) Care (c) Storage (d) Use	④Same as 2.22	II. Select and use metric measuring tools
	BENCH WORK			
2.5	HAND ASSEMBLY & FITTING			
2.51	Student will assemble an assembly with fasteners using proper tools and techniques.	I. Fasteners (a) Types (b) Drivers (c) Uses	④Read pp. 1150-1274 Instructor demonstration	I. Assemble parts with screws and nuts
2.52	Student will make mating parts demonstrating the different fits.	II. Fits (a) Shrink (b) Force (c) Running (d) Proper fits using prussian blue	③Project - M.S.P.M. Dwgs. # 14, 18, 18-A&B, 21 ④Read pp. 1545-1569	II. Fit parts using shrink force and running method
2.7	SUPPLEMENTAL OPERATIONS			
2.72	Student will broach workpiece, using proper tools and techniques	III. Broaches (a) Types (b) Care and Uses	④Read pp. 1932-1940 Instructor demonstration AV 233	III. Select and use hand broaching tool.

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
2.76	Student will extract a broken screw from workpiece using proper tools and techniques	IV. Tap and screw extractors (a) Types (b) Uses and care	④Read p. 1449	IV. Extract screws and taps
2.8	INSPECTION			
2.81	Student will set up and demonstrate equipment.	I. Set up equipment (a) Use (b) Care (c) Types	④Read pp. 1890-1892	I. Set up equipment
2.82	Student will be instructed in electronic and all gauges.	II. Electronic and other gauges (a) Use (b) Care (c) Types	Plant tour of facility with equipment available for demonstration	II. Use of electronic and other gauges
	POWER SAWING			
3.1	RECIPROCATING & CONTINUOUS BAND CUT-OFF SAW			
3.11	Select proper number of teeth in blade. Use proper installing procedure.	I. Blades (a) Thickness of workpiece	①Read pp. 72-74 AV 241	I. Select and install blade
3.12	Calculate proper cutting speed for cutting materials and maintain feed. What contour is to be cut.	II. Feed and speed (a) Type material (b) Type of cutting (Conventional or friction)	④Read p. 1787	II. Calculate proper cutting speed for cutting material and maintain feed
3.2	CONTOUR BAND SAW			

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
3.21	Select blade width and proper number of teeth in blade. Use proper installing procedures.	I. Blade (a) Thickness of work-piece (b) Radius of cut	①Read pp. 99-105	I. Select correct blade
3.22	Blade ends meet square-ly & make good contact to electrodes. Grind or file weld area to allow blade to pass through edge.	II. Weld blade (a) Fitting and clamping (b) Weld settings (c) Smooth weld to fit (d) Gauge	①Read pp. 93-98 AV 69	II. Weld blade and test by bending for quality weld
3.23	Proper clearance on guides for saw width. Blade runs on rubber band centered on wheels.	III. Install blade (a) Guides (b) Wheels (c) Blade wipers	①Same as 3.21	III. Install blade
3.24	In addition to Q-1 the student will be in-structed in speed and feed to do the job correctly, such as the number of teeth, the width of the blade, the thickness of the blade, what contour is to be cut, the material to be cut, different types of cutting, such as conventional cut-ting or friction cutting.	IV. Feed and speed (a) Speed control (b) Coolant (c) Feed mechanism	①Same as 3.21 ③Project #17	IV. Select feed and speed
3.26	In addition to Q-1 the student will learn the type of blade, width, thickness, num-ber of teeth, material	V. Contour saw (a) Blade width	③Projects - M.S.P.M. Dwgs #14, 26 AV 72	V. Contour sawing a part

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
3.26 (cont.)	to be cut, determine if conventional sawing or friction sawing. Use attachments provided with the machine being used.			
	DRILLING OPERATIONS			
4.1	HAND FEED DRILL			
4.11	Select correct drills and use in machine to drill hole sizes for taps and counterbores.	I. Drills (a) Use of drill charts (b) Verify drill size by use of micrometers (c) Methods of drill grinding (d) Method of checking grind angles (e) Correct drill sizes for tapped holes (f) Correct drill sizes for counterbored holes	①Read pp. 124-128 ③Projects - M.S.P.M. Dwgs. #1 through 9, 12, 14 & 16 AV 84 AV 85 AV 90	I. Select correct drill and drill holes
4.12	Select correct countersink for use in deburring, seating, exterior, interior and surface finish requirements.	II. Countersinks (a) Type for application (b) Methods of gauging (c) Use of charts for type of countersink	④Read p. 1640 AV 82	II. Select correct tool and use to countersink required shape. Gauge for accuracy.
4.13	Select correct counterbore for use in counterboring for screw	III. Counterbores (a) Type for application	④Read pp. 1668 - 1669 AV 89	III. Select correct tool and use to counterbore required shape and

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
4.13 (cont.)	heads, spotfaces, spring pockets, and opening up holes.	(b) Methods of gauging (c) Use of charts to select counterbore tool		gauge for accuracy
4.14	Select correct reamer for use in different type of metals. Use in machine and by hand operation to obtain correct hole size and finish	IV. Reamers (a) Type for application (b) Methods of inspection surface finish (c) Use of charts for material allowances for reaming (d) Methods of gauging	③Projects - M.S.P.M. Dwgs. # 21, 24 ④Read pp. 1636-1654 AV 91	IV. Select correct reamer and ream a hole to the desired size and finish
4.15	Select proper tap, (taper, plug, bottom) and locate concentric with workpiece hole. Apply coolant and turn top CW-CCW through workpiece part.	VI. Taps (a) Types (b) Workpiece (c) Stops (d) Coolant (e) Lubricant (f) Gauges (g) Classes of threads and fits	③Projects - M.S.P.M. Dwgs. 16, 22, 23, 25, 26 Read pp. 1429-1449 ⑤Read complete pamphlet AV 92 ②Memory jogger #1	VI. Select tool and tap a hole to correct size for the class of fit required
	LATHES			
5.1	ENGINE LATHE			
5.11	Student will true stock beginning with chalk and completing with indicator to within .001 TIR.	I. Independent chucks (a) Types (b) Use of proper type indicator (c) Correct type of jaws	①Read pp. 201 & 248 ③Projects - M.S.P.M. Dwgs. #8 through 11, 16, 21, 22 AV 113 AV 152	I. Set up work in independent chuck to required tolerance
5.17	The student will calculate speeds and feeds by using a machinist handbook and charts.	II. Speeds and Feeds (a) Books (b) Charts (c) Slide rule calculators (d) Formulas (e) Types of materials	①Read pp. 559 & 567 & 569 AV 133	II. Apply correct speeds and feeds for use in machining a type of material

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
5.18	The student will grind and hone cutting tools for use in machining operations.	III. Cutting tools (a) Right hand turning tool (b) Left hand turning tool (c) Multi-purpose tool (d) Cutoff tool (e) Acme threading tool (f) Convex radius tool (g) Concave radius tool	①Read pp. 180-199 ④Read pp. 1853-1869 AV 129 AV 130 ②Progress quiz #12	III. Grind tools to required geometry to make parts to specifications
5.19	The student will turn and face a part using a gauge for the finish required and calculate time to finish part beginning after part is set up.	IV. Turn and face (a) Surface finish gauges (b) Metal remover rate formulas (c) Set up sheets	①Read pp. 236-244 ③Projects - M.S.P.M. Dwg. #18 AV 104 AV 134	IV. Predetermine the time and finish re-required and perform turning and facing operation
5.111	Student will turn or bore taper using calculation methods by offset of tailstock, taper attachment and compound method.	V. Taper turning principles (a) Taper standards (b) Taper turning methods (c) Gauging and measuring of tapers	③Projects - M.S.P.M. Dwgs., #8,22,23,24 AV 137-145	V. Perform taper operations
5.112	The student will drill and ream a part to + or - .0005 tolerance and selecting proper speed and feed, drill and reamer.	VI. Drilling and reaming (a) Type for application (b) Methods of holding (c) Methods of inspecting surface finish (d) Use of charts for material allowances (e) Methods of ga[illegible]ing	③Projects - M.S.P.M. Dwgs. #22,23,24 AV 102 AV 103 AV 131	VI. Drill and ream a hole

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
5.113	Student will bore a part using the largest tool to allow correct clearances with least amount of overhang of bar. Use correct setup speeds and feeds.	VII. Boring principles (a) Types and sizes of boring bars (b) Types and sizes of boring tools (c) Feeds and speeds (d) Lubricants	①Read p. 565 ③Projects - M.S.P.M. Dwgs. #18A, 24, 32A&B ④Read pp. 1670-1676 Read pp. 1826-1835 AV 116 AV 117 AV 128	VII. Perform boring operations on given parts
5.117	Student will select proper tools for the specifications of sample, print or sketch, form free hand operations and check with gauge. Calculate speed for job.	VIII. Freehand principles (a) Select type of tool (b) Feed and speed (c) Lubricant	③Projects - M.S.P.M. Dwgs. #7, 22 AV 146 AV 147 ②Progress quiz #13	VIII. Perform freehand operations on given part
	MILLING AND SIMILAR MACHINING OPERATIONS			
6.1	MILLING MACHINES			
6.11	The student will operate various controls and select cutters for different jobs, insuring cutters are free of foreign materials, nicks, and burrs. Hubbs, spacers, and keys and arbors selected. Cutter check for proper rotation	I. Milling machines and cutters (a) Types (b) Sizes (c) Accessories (d) Use and handling (e) Lubrication (f) Storage	①Read pp. 284-292 AV 156-158 AV 160 AV 170 AV 172	I. Select correct equipment and mount on machine and properly store equipment after use

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
6.13	The student will select the proper cutters, speeds, feeds and use safe practices to perform the type of milling of flat surfaces, according to type materials and coolants used. Use prints and inspect part as to specification.	II. Milling flat surfaces (a) Basic milling principles (b) Conventional milling procedures (c) Climb milling procedures (d) Materials (e) Cutter selections (f) Feeds and speeds (g) Lubricant (h) Safe practice	①Read pp. 279-284 ③Projects #4,5,6,11,12,23 AV 161-163 AV 175-177	II. Mill a flat surface; face, side and radius
6.14	The student will select type of cutter (woodruff, endmill, or plain) and cut keyway to specifications on print, sketch or sample using standard milling machine practices.	III. Milling keyways (a) Types and sizes of keyways (b) Materials (c) Keyway cutters (d) Standards and tolerances (e) Speeds and feeds (f) Lubricants (g) Safe practice	①Read p. 295 ④ Read pp. 992-1014 AV 167	III. Mill keyways
6.15	The student will drill and ream a hole in a part using methods used on drill machines. Drill and bore a hole to specifications.	IV. Drill, ream and bore (a) Types and sizes (b) Materials (c) Index head use and procedures (d) Feeds and speeds (e) Measurements and tolerances (f) Lubricants (g) Safe practices	④Read pp. 1774-1783	IV. Drill, ream, and bore holes

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
6.20	The student will calculate or refer to charts or tables on all milling machine projects.	VI. Speeds and feeds	①Read pp. 322-327 ④Read pp. 1752-1773 AV 159 AV 164 AV 174 ②Progress quiz #19	VI. Select correct speeds, feeds
	ABRASIVE MACHINING			
8.1	PRECISION SURFACE GRINDING			
8.11	Student will operate the various controls, set table dogs and adjust cross feed.	I. Machine controls (a) Start and stop switch for wheel (b) Magnetic chuck control (c) Table traversing and reversing dog (d) Cross feed adjustment and controls (e) Coolant control	Instructor demonstration	I. Operate machine controls
8.12	Student will select proper wheel by referring to code number on wheel and check wheel for imperfections. He	II. Wheel identification (a) Code (b) Master switch (c) Wrenches	①Read pp. 443-449 AV 198	II. Select correct wheel, check for imperfections and install wheel and adjust all safety devices.

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
8.12 (cont.)	will cut off motor switch and install wheel on grinder, adjusting all safety devices.			
8.14	Student will mount the diamond holder, position the wheel and dress the wheel.	III. Wheel dressing procedure (a) Safe practices and procedures	④Read pp. 1991-2008 AV 199	III. Dress the wheel of the grinder
8.16	The student will position the piece on the chuck, adjust the table traverse dogs and cross feed, spark the piece and grind to dimension.	IV. Grinding wheels (a) Types (b) Care (c) Work holding method - a magnetic chuck	④Read pp. 1976-1991 ③Projects #4,5,6 AV 200 AV 201	IV. Grind a flat surface
8.115	Select proper chuck and attachment and complete desired setup to produce workpiece to print tolerances.	V. Types of chucks and attachments (a) Permanent magnet chuck (b) Electromagnets (c) Sine (d) Adapter plate (e) Laminated blocks (f) Magna-vise clamps (g) Double-faced tape (h) Angle plates (i) Vee blocks	⑥Read pp. 110-110 and 114-130	V. Use correct magnetic chuck and attachments to grind workpiece.
8.116	Select and install proper wheel and crush roll or dresser and form wheel to desired shape.	VI. Types of dressers and crush grinders (a) Idler crushing units (b) Power driven crushing units	⑥Read pp. 131-138	VI. Use brake dresser and crush grinder to form wheel to print specifications

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
8.116 (cont.)		(c) High speed steel rolls (d) Carbide		
8.7	BUFFING AND POLISHING			
8.71 thru 8.75	Select proper wheel and buffing or polishing agent and perform operation desired	I. Polishing and buffing (a) Types of polishing wheels (b) Types of buffing wheels (c) Speeds of wheels (d) Grain numbers of emery (e) Grades of emery cloth (f) Polishing operations (g) Mixture for cementing emery cloth to a lapping wheel	④Read pp. 2043-2044	I. Buff a flat surface

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* Activity Experience Column: Note 1: The following numbers will indicate textbooks included as suggested texts:
1. Machine Shop Operation and Set-Up - Text
2. Machine Shop Operation and Set-Up - Workbook
3. Machine Shop Project Manual
4. Machinery's Handbook
5. Facts about Tapping
6. Grinding Technology

Note 2: AV indicates audio-visual numbers which are listed with available source in Chapter VII of the curriculum manual

SUGGESTED TEXTS

1. Machine Shop Operations & Setup
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

2. Machine Shop Operations & Setup Study Guide
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

3. Machine Shop Project Manual
   Program Development
   Department of Community Colleges
   Raleigh, North Carolina - 1977

4. Machinery's Handbook
   Oberg, Jones & Horton
   Industrial Press
   New York - 20th Ed. - 1976

5. Facts About Taps and Tapping
   Greenfield Tap and Die Co.
   Greenfield, Mass. 01301

6. Grinding Technology
   Krar & Oswald
   Delmar Publications
   Albany, New York - 1974

Note - Number beside text agrees with numbering system used in course outline.

GEOMETRY covers fundamental properties and definitions; plane and solid geometric figures; selected general theorems; geometric construction of lines, angles and plane figures; dihedral angles; areas of plane figures; volumes of solids. Geometric principles are applied to shop operations.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Mensuration of triangles

II. Mensuration of quadrilaterals

III. Mensuration of polygons

IV. Mensuration of circles

V. Mensuration of constant section solids

VI. Mensuration of non-constant-section solids

VII. Mensuration in lever systems

VIII. Useful geometrical theorems

SUGGESTED TEXT:

Thies, Matthias A. Industrial Mathematics. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959.

SUGGESTED REFERENCES:

Mandelbaum, Hugo and Conte, Samuel. Solid Geometry. New York: The Ronald Press Company, 1957.

Nelson, Gilbert D., Moore, Frank C., Hamburger, Carl. General Mathematics for the Shop. Boston: Houghton Mifflin Company, 1956.

Palmer, Claude Irwin and Bibb, Samuel Fletcher. Practical Mathematics, Part III, Geometry with Applications; Fifth Edition. New York: McGraw-Hill Book Company, Inc., 1950.

SUGGESTED REFERENCES CONTINUED:

Rusinoff, S. E. Mathematics for Industry. Chicago: American Technical Society, 1958.

Stout, Claude E. Shop Mathematics. New York: John Wiley & Sons, Inc., 1955.

Wolfe, John H. and Phelps,Everett R. Practical Mathematics, Volume I--Elementary; Fourth Edition. New York: McGraw-Hill Book Co., Inc. 1958.

DFT 1105

BLUEPRINT READING: MECHANICAL provides further practice in interpretation of blueprints as they are used in industry; study of prints supplied by industry; making plans of operations; introduction to drafting room procedures; sketching as a means of passing on ideas, information and processes.

PREREQUISITE: DFT 1004.

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	1	2	2

I. Drafting tools and techniques

II. Working drawing: Procedures and techniques

III. Fasteners

IV. Pictorial drawing

V. Advanced blueprint reading

SUGGESTED TEXTS:

McCabe, Keith and Farnham. Mechanical Drafting Essentials; Third Edition. Englewood Cliffs; Prentice-Hall, Inc.

Ihne and Streeter. Machine Trades Blueprint Reading: Third Edition. Chicago: American Technical Society.

INTRODUCTION TO METALS is designed to familiarize the student with the different properties of ferrous and nonferrous metals. It provides a background for understanding the physical changes and chemical metallurgy of producing raw metal. The course explains the material designation system, classifications of steels, trade names and cross reference information for comparable materials. Common shop terms used in treatment of metals will be explained.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	2	4

I. Metals for machining and production methods

II. Physical Metallurgy

III. Theory of alloys

IV. Metals for machining; how produced; defects

V. Bearing metals

VI. Copper and alloys

VII. Carbon steels

VIII. Cast iron

IX. Powder metallurgy

SUGGESTED TEXTS:

Johnson and Weeks. Metallurgy (Book and Study Guide). Chicago: American Technical Society.

Palmer, Frank R. and Luerssen, George V. Tool Steel Simplified. Reading, Pennsylvania: Carpenter Steel Company, Latest Edition.

SUGGESTED REFERENCES:

ASM Metal Handbook. Novelty, Ohio: American Society for Metals.

Frier, William T. Elementary Metallurgy. New York: McGraw-Hill Book Company, Inc., Latest Edition.

SUGGESTED REFERENCES CONTINUED:

Weiss and Leuchtman. Properties and Uses of Ferrous and Nonferrous Metals. Detroit: Royalle Publishing Company, Inc.

COMMUNICATION SKILLS is designed to promote effective communication through correct language usage in speaking and writing.

PREREQUISITE: ENG 1101

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Sentence structure

II. Written expression

III. Talking and listening

IV. The report form

SUGGESTED TEXT:

Shurter, Robert LeFevre. Written Communications in Business. New York: McGraw-Hill Book Company, Inc., 1957.

SUGGESTED REFERENCES:

Hodges, John C. Harbrace College Handbook; Fourth Edition. New York: Harcourt, Brace and World, Inc.

Sherman, Theodore Allison. Modern Technical Writing. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1958.

Webster's New Collegiate Dictionary. Springfield, Massachusetts: G. & C. Merriam Company.

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COURSE OUTLINE

MEC 1103 - MACHINE SHOP THEORY AND PRACTICE

Developed By

Machinist Competency Curriculum Committee

May 1979

PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEC 1103 - MACHINE SHOP THEORY AND PRACTICE

DESCRIPTION OF COURSE:

Additional instruction and practice in the use of precision measuring tools, milling machines, and surface grinders. Practice in setting up and operating machine tools including the selection and use of work holding devices, feeds and speeds, special heads and tables, cutting tools, and coolants. Instruction and practice in the use of power feed drills and abrasive saws.

Course Hours Per Week:	Class, 3; Laboratory, 12
Quarter Hours Credit:	7
Prerequisite:	MEC 1102
Course Objectives:	Specific objectives are included in the outline of instruction.
Course Outcomes:	Upon completion of the third quarter of the machinist curriculum, the student should be qualified to perform entry level work as a set-up operator. This course should focus on developing advanced skills in working with hand tools and precision measuring tools, and operating selected machines, intermediate skills in setting-up machine tools, and basic skills in the use of power feed drills and abrasive saws.

MEC 1103

MACHINE SHOP THEORY AND PRACTICE

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE*	PERFORMANCE OBJECTIVES
	BENCH WORK			
2.2	MEASURING TOOLS			
2.22	The student will be instructed in electronic and air gauging	I. Precision measuring tools (a) Types (b) Care (c) Storage (d) Use	⑦Read pp. 8-58	I. Select and use precision tools
	POWER SAWING			
3.3	ABRASIVE SAW			
3.31	Student will clamp wheel between flanges and replace guards. Correct fitting wrench will be used to remove and replace nuts.	I. Abrasive wheels (a) Types (b) Care and uses (c) Coolants to use (d) Mounting procedures	④Read pp. 2030-2031	I. Select and mount correct wheel
3.32	Speed control set to correct cutting speed for workpiece material. Coolant applies where practical. Feed mechanism adjusted to apply correct pressure.	II. Feed and speed (a) Speed control (b) Coolant (c) Feed mechanism	④Same as 3.31	II. Select feed and speed
3.33	Set workpiece clamp to hold work secure.	III. Work holding devices (a) Types (b) Care and uses	④Same as 3.31	III. Clamp workpiece

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
3.34	Workpiece should be sawed to prescribed length (+ or - 1/16"). Coolant must be applied in cutting tool steel	IV. Operation of machine (a) On-off (b) Feed methods (c) Work clamping methods (d) Coolant (e) Stops	Instruction demonstration of controls, safety and use of machine	IV. Cut part to specifications
	DRILLING OPERATIONS			
4.2	POWER FEED DRILL			
4.21	Check drill size by use of a drill gauge; determine if drill is high speed steel and properly sharpened. Set proper RPM and feed rate and set stop for the bottom of blind hole.	I. Drills (a) Types and quality of drills (b) Identify parts of drill (c) Feeds (inches per revolution) (d) Location and use of feed table (e) Stops	①Read pp. 107-111 ③Projects #17 & 19 AV 86 AV 90	I. Select correct drill and drill a hole
4.22	Set the machine stop to the correct depth of countersink and set the speed of the machine to the proper revolutions per minute.	II. RMS gauging (a) Speciman blocks (b) Profilometer	⑦Review pp. 42-54 AV 79 AV 80	II. Select correct countersink and countersink a hole
4.23	Locate the drill over the workpiece, set cutting speed and power down feed set by the table located on the face of the machine.	III. Counterboring (a) Types of counterbores (b) Sizing methods (c) Speeds (d) Lubricants (e) Depths (f) Stops	①Review p. 130	III. Select correct counterbore and counterbore a hole

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
4.24	Locate workpiece hole concentric with reamer. Apply coolant and set the speed of machine to the proper revolutions per minute.	IV. Reaming (a) Types of reamers (b) Sizing (straight or taper) (c) Speeds (d) Lubricants (e) Coolant (f) Workpiece (g) Stops	①Review p. 131	IV. Select correct reamer and ream a hole
4.25	Tap a hole.	V. Tapping (a) Types of taps (b) Thread systems (c) Tap drill sizes (d) Lubricants (e) Tapping attachments (f) Speeds	④Read pp. 1684-1721 ③Projects # 16 & 17	V. Select correct tap and tap a hole
4.26	Select hone size, gauge and speed to finish predrilled hole to proper finish, size, and tolerance.	VI. Hone (a) Gauge (b) Speed and feed (c) Finish	①Read pp. 216-217 ④Read pp. 1825 & 2031-2034 ③Project #37	VI. Select correct hone size and hone a hole
4.27	Select proper lap material compound and speed to finish pre-drilled hole to proper finish, size, and tolerance.	VII. Lap (a) Material (b) Compound (c) Gauge (d) Finish	④Read pp. 1913 & 2035-2038 ③Project #37	VII. Lap a hole to correct size
	LATHES			
5.1	ENGINE LATHE			
5.11	The student will true stock beginning with chalk and completing	I. Alignment procedures; internal and external (a) Chalk methods	Instructor demonstration ③Projects #9, 22, 33 AV 114	I. Set up work in independent chuck

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
5.11 (cont.)	with indicator to within .001 TIR.	(b) Concentric rings (c) Lathe tool (d) Wiggler (e) Dial indicator	AV 135 AV 108 AV 110 ②Progress quiz #13	
5.18	The student will grind and hone a convex and concave radius tool to a gauge and machine a part to print specifications.	II. Selecting and grinding tools (a) Type and kind of tools (single, gang) (b) Grinding procedures-special (c) Application of tools (d) Gauging of tools (e) Tool holder (types)	Instructor demonstration AV 123 ②Progress quiz #14	II. Select and/or grind of cutting tools
	MILLING AND SIMILAR MACHINING OPERATIONS			
6.1	MILLING MACHINES			
6.11	The student will indicate the cutter holding arbors to insure running true. Use soft hammer to straighten arbors. Insure indicator is used with care.	I. Milling cutters (a) Types (b) Sizes (c) Special use and handling (d) Lubrication	①Read pp. 308-316 AV 160 AV 171	I. Select correct milling cutters and mount
6.12	The student will demonstrate set up of parts using table, vises, indexing heads, rotary table fixtures and special set-ups.	II. Work Holding Devices (a) Table (b) Vises (c) Indexing heads (d) Rotary table (e) Fixtures	①Read pp. 292-306 AV 173	II. Selecting and mounting work holding devices

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
6.13	The student will set-up part and mill parallel to within .003 and square to within $0^{o}30'$		①Read pp. 316-337 ③Projects #17 & 19 AV 179 AV 166 AV 178	III. Mill a flat surface to correct size
6.14	The student will set up and mill a woodruff key seat to specification from tables in Machinist's Handbook.		④Read pp. 468 & 1625-1626 & 991-1014 & 1034 AV 167 AV 182	IV. Mill keyways to correct size
6.15	The student will set-up, drill and ream a through hold to + or - .0005 and drill and bore a blind hole flat in the bottom to within + or - .001 and + or - .001 on ID.		Instructor demonstration on vertical mill (bridgeport) ③Project #30A	V. Drill, ream, and bore holes
6.19	The student will select at least (2) cutters of same dia. or different diameters and straddle mill a part using standard milling machine practices.	V. Straddle and gang milling operations (a) Types of cutters (b) Cutter spacing (c) Materials (d) Feeds and speeds (e) Angular tolerances (f) Coolants (g) Safety practices	①Read pp. 334-336 ③Project #16 AV 181	V. Perform straddle and gang milling opera...
6.110	The student will calculate speeds and feeds from Machinist's Handbook		④Read pp. 1773-1786 AV 164	VI. Select feeds and speeds

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	Performance OBJECTIVES
	SHAPER-PLANER OPERATIONS			
7.1	SHAPER-PLANER OPERATIONS			
7.11	The student will select feeds and speeds by calculation as to type of tool and material being cut. Calculate stock removal and adjust stroke and position of stroke for ½ at beginning and ⅛ at end of stroke.	I. Principles of feed and speed selection (a) Calculate speed (b) Calculate feed (c) Calculate stock removal (d) Understand cutting speeds for different materials (e) Adjustment principles of position, length, and overtravel	④ Read pp. 1791-1792 AV 207	I. Select proper feeds and speeds and make adjustments
7.12	Mount workpiece, tool and set speeds and feeds for desired finish	II. Shape horizontal surface (a) Type of tool (b) Rough cuts (c) Finish cuts (d) Position of clapperbox (e) Speeds and feeds (f) Position of vise	① Read pp. 270-274 AV 207-212 AV 214 ⑦ Read pp. 208-210	III. Shape and plane a horizontal surface on a workpiece
7.15	Mount workpiece, tool and set speeds and feeds for desired finish	III. Shape vertical surface See 7.12	① Read pp. 274-275 AV 213	III. Shape and plane a vertical surface on a workpiece
7.16	Mount workpiece, tool and set speeds and feeds for desired finish	IV. Shape angular surface See 7.12	① Read pp. 275-277 AV 215 ⑦ Read pp. 210-211	IV. Shape and plane an angular surface on a workpiece

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
7.17	Mount workpiece, tool and set speeds and feeds for desired finish	V. Use forming tool See 7.12	④ Read p. 1807	V. Use a forming tool for shaping and planing
7.18	Mount workpiece, tool and set speeds and feeds for desired finish	VI. Use index head See 7.12	AV 216 ⑦ Read pp. 212-214 ② Progress quiz #18	VI. Shape or plane using index heads
	ABRASIVE MACHINING			
8.1	PRECISION SURFACE GRINDING			
8.17	Select proper wheel, relieve side and grind workpiece	I. Grinding a vertical surface (a) Wheel clearance (b) Corner relief (c) Rough and finish grinding (d) Feed rate	⑥ Read pp. 119-121	I. Grind a vertical surface

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* Activity Experience Column: Note 1: The following numbers will indicate textbooks included as suggested texts:

1. Machine Shop Operation and Set-Up - Text
2. Machine Shop Operation and Set-Up - Workbook
3. Machine Shop Project Manual
4. Machinery's Handbook
5. Facts about Tapping
6. Grinding Technology
7. Technology of Machine Tools

Note 2: AV indicates audio-visual numbers which are listed with available source in Chapter VII of the curriculum manual.

SUGGESTED TEXTS

1. Machine Shop Operations & Setup
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

2. Machine Shop Operations & Setup Study Guide
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

3. Machine Shop Project Manual
   Program Development
   Department of Community Colleges
   Raleigh, North Carolina - 1977

4. Machinery's Handbook
   Oberg, Jones & Horton
   Industrial Press
   New York - 20th Ed. - 1976

5. Facts About Taps and Tapping
   Greenfield Tap and Die Co.
   Greenfield, Mass. 01301

6. Grinding Technology
   Krar & Oswald
   Delmar Publications
   Albany, New York - 1974

7. Technology of Machine Tools
   Krar, Oswald, Amand
   McGraw-Hill - Gregg Division
   New York - 2nd Ed. - 1977

Note - Number beside text agrees with numbering system used in course outline.

TRIGONOMETRY, covers trigonometric ratios; solving problems with right triangles, using tables, and interpolating; solution of oblique triangles using law of sines and law of cosines; graphs of the trigonometric functions; inverse functions, trigonometric equations. All topics are applied to practical problems.

PREREQUISITE: MAT 1103.

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Introduction to trigonometry

II. Principles of triangles

III. Trigonometric ratios

IV. Practical problems involving the right triangle

V. Oblique triangles and their solutions

VI. Reduction formulas

VII. Graphical representation of the trigonometric functions

VIII. Inverse trigonometric functions

IX. Trigonometric equations

SUGGESTED TEXTS AND REFERENCES:

Brink, Raymond W. Plane Trigonometry. New York: Appleton-Century-Crofts, Inc., 1959.

Carson, Albert B. Plane Trigonometry Made Plain. Chicago: American Technical Society, 1957.

Dadourian, H. M. Plane Trigonometry - With Tables. Reading, Massachusetts: Addision-Wesley Publishing Company, Inc., 1950.

Dubisch, Roy. Trionometry. New York: The Ronald Press Company, 1955.

Heineman, E. Richard. Plane Trigonometry: Second Edition. New York: McGraw-Hill Book Company, Inc., 1956.

SUGGESTED TEXTS AND REFERENCES CONTINUED:

Niles, Nathan O. Plane Trigonometry. New York: John Wiley and Sons, Inc., 1959.

Palmer, C. I. and Bibb, S. F. Practical Mathematics - Part IV. New York: McGraw-Hill Book Company, Inc., 1951.

Perlin, I. E. Trigonometry. Scranton: International Textbook Company, 1956.

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DFT 1106

BLUEPRINT READING: Mechanical is a course in advanced blueprint reading and sketching as related to detail and assembly drawings used in machine shops. The interpretation of drawings of complex parts and mechanisms for features of fabrication, construction and assembly.

PREREQUISITE: DFT 1105

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	1

I. Drafting tools and techniques

II. Working drawing

III. Fasteners

IV. Dovetail

V. Taper pins, dowel pins

VI. Molding; castings

VII. Worm gears

VIII. ASA Symbols & SAE Standards

IX. Pictorial drawing

X. Advanced blueprint reading

SUGGESTED TEXTS:

Ihne and Streeter. Machine Trades Blueprint Reading; Third Edition. Chicago: American Technical Society.

Olivo and Payne. Basic Blueprint Reading and Sketching; 1952. Albany: Delmar Publishers, Inc.

Spencer and Dygdon. Basic Technical Drawing; New York: The Macmillan Company.

Blueprint Reading for Machinists: Intermediate. Delmar Publishers Inc. Albany, New York.

MEC 1119

APPLIED METALLURGY covers practical metallurgy theory and practice in the treatments of ferrous and non-ferrous metals. The actual practice of heat treatment will be performed on sample materials with emphasis on low and high carbon steels. Relationships between part design and heat treatment will be applied. Testing equipment for verification of correct treatment will be used.

PREREQUISITE: MEC 1118

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	2	3	3

I. Heat treatment for steel

II. Heat treating furnaces and equipment

III. Relationship between part design and heat treatment

IV. Experiments

SUGGESTED TEXT:

Johnson and Weeks. Metallurgy. Chicago: American Technical Society.

SUGGESTED REFERENCES:

ASM Metal Handbook. Novelty, Ohio: American Society for Metals.

Frier, William T. Elementary Metallurgy. New York: McGraw-Hill Book Company, Inc., 1952.

Metals Technology. Albany, New York: University of the State of New York.

Palmer, Frank R. and Luerssen, George V. Tool Steel Simplified. Reading, Pennsylvania: Carpenter Steel Company, 1960.

Weiss and Leuchtman. Properties and Uses of Ferrous and Nonferrous Metals. Detroit: Royalle Publishing Company, Inc.

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PSY 1101

HUMAN RELATIONS is a study of basic principles of human behavior. The problems of the individual are studied in relation to society, group membership, and relationships within the work situation.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Basic principles of human behavior

II. Striving to understand human relations

III. Behavior and problems in living

IV. Striving to become an effective worker

SUGGESTED REFERENCES:

Textbook: Milliken, Mary Elizabeth, Understanding Human Behavior. Albany, New York: Delmar Publishers, 1969.

Dennis, Lorraine Bradt. Psychology of Human Behavior for Nurses. Philadelphia; W. B. Saunders Company, 1967.

Gilmer, B. von Haller. Applied Psychology: Problems in Living and Work. New York: McGraw-Hill Book Company, 1967.

Heckel, Robert V., and Rose M. Jordan. Psychology: The Nurse and the Patient. St. Louis: C.V. Mosky Company, 1967

Heider, Fritz. The Psychology of Interpersonal Relations. New York: John Wiley and Sons, Inc., 1958.

Hepner, Harry Walker. Psychology - Applied to Life and Work. Englewood Cliffs, N.Y.: Prentice Hall, Inc., 1957.

Laird, Donald A., and Eleanor C. Laird. The Technique of Handling People. New York: McGraw-Hill Book Company, 1954.

Laird, Donald A., and Eleanor C. Laird. Human Relations and Motivation. New York: McGraw-Hill Book Company, 1967.

COURSE OUTLINE

MEC 1104 - MACHINE SHOP THEORY AND PRACTICE

Developed By

Machinist Competency Curriculum Committee

May 1979

PROGRAM DEVELOPMENT
DEPARTMENT OF COMMUNITY COLLEGES
STATE BOARD OF EDUCATION
RALEIGH, NORTH CAROLINA

MEC 1104 MACHINE SHOP THEORY AND PRACTICE

DESCRIPTION OF COURSE:

The student will work to required tolerances setting up and operating machine tools. An introduction to turret lathes, advanced milling machine operations, special machining operations, and special machines. Also covered will be grinding specific surfaces using hand, surface and cylinderical grinders, and lapping and honing parts to specified tolerances.

Course Hourse Per Week:	Class, 3; Laboratory, 12
Quarter Hours Credit:	7
Prerequisite:	MEC 1103
Course Objectives.	Specific objectives are included in the outline of instruction.
Course outcomes:	Upon completion of the fourth quarter of the machinist curriculum, the student should have the basic background to enable reasonable progression in the trade to the level of machinist. This course should focus on developing efficient and effective skills in the operation and set-up of machine tools for production purposes. In addition, it should provide an introduction to a variety of special machining operations and special machines. Tolerances and finishes to specification will be emphasized.

MEC 1104

MACHINE SHOP THEORY AND PRACTICE

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE*	PERFORMANCE OBJECTIVES
	BENCH WORK			
2.5	HAND ASSEMBLING AND FITTING			
2.53	The student will lap parts using proper compounds and techniques.	I. Laps (a) Types (b) Uses (c) Lapping compounds (grits)		I. Lap parts to fit
2.6	PORTABLE POWER TOOLS			
2.62	Student will select and use hand grinder	I. Hand grinders (a) Types (b) Uses and Care (c) Grinding wheels and brushes	④Read pp. 2024-2030 Instructor demonstration of controls, safety, and use	I. Use hand grinder
2.7	SUPPLEMENTAL OPERATIONS			
2.73	Student will assemble an assembly with rivets using proper tools and techniques.	I. Rivets (a) Types (b) Tools (c) Installation	④Read pp. 1257 - 1274	I. Assemble with rivets
	DRILLING OPERATIONS			
4.1	HAND FEED DRILL			
4.16	Select hone size, gauge and speed to finish predrilled hole to proper finish, size, and tolerance.	I. Hone (a) Gauge (b) Speed and feed (c) Finish	④Review pp. 2031-2034 ③Project #37 (cont.)	I. Select correct hone size and hone a hole

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
4.17	Select proper lap material compound and speed to finish pre-drilled hole to proper finish, size, and tolerance.	II. Lap (a) Material (b) Compound (c) Gauge (d) Finish	④Review pp. 2035-2038 ③Project #37 (cont.)	II. Lap a hole to correct size
	LATHES			
5.1	ENGINE LATHE			
5.13	Student will true stock beginning with chalk and completing with indicator to within .001 TIR (Total indicator reading).	I. 4-Jaw and magnetic chuck (a) Types (b) Use of proper type indicator (c) Correct type of jaws	⑦Read p. 148 AV 109 AV 136 AV 127 ②Progress quiz #15	I. Set up work in combination chuck to required tolerance
5.16	Student will bolt part to face plate and balance with weights by disengaging head-stock gears and noting if chuck stops at different spot each time when turned by hand.	II. Clamping procedures (balancing)	①Read pp. 248-251 ⑦Read pp. 293-296 Project-resurface auto-mobile flywheel or similar object	II. Set up work on a face plate
5.114	Student will set up tool post grinder and grind lathe center.	III. Grinding principles (a) Proper setup procedures (b) Types of wheels (c) Type of material	①Read p. 216 ③Projects #18A, 18B, 30 or grind lathe centers AV 206 ②Progress quiz #16	III. Perform tool rest grinding operations
5.2	TURRET LATHES			

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
5.21 and 5.22	The student will set up and machine a part using stops. Face center drill and bore to print tolerances. Turn, groove and thread with die and cut-off part. Check thread using the three wire method and thread gauge. Speeds and feed, lubricants and tool selection selected from experience on engine lathes and ready reference charts.	I. To set up Turret Lathe (a) Basic steps (common to all first operations of a lathe job) (b) Types and sizes of turret lathes (1) Ram (2) Saddle (3) Vertical screw machine (c) Lubricants (d) Speed and feeds (e) Selecting of tools (f) Stops	(1) Read pp. 368-389 (3) Projects #32-A, 32-B, 33, 35 (2) Progress quiz #17 AV 153-155	I. Set up rear turret tooling and stops and set up cross slide tooling and stops
106	MILLING AND SIMILAR MACHINING OPERATIONS			
6.1	MILLING MACHINES			
6.11	The student will mount cutter and indicate to ensure cutter is running true. Straighten arbor if run out.	I. Milling cutters (a) Types (b) Sizes (c) Accessories (d) Use and handling (e) Lubrication (f) Storage	(1) Review pp. 284-292 (4) Read pp. 770 & 894 & 1606-1633 AV 165 AV 183	I. Select and mount milling cutter
6.12	The student will show ability to use work-holding devices to set up parts.	II. Workholding devices (a) Table (b) Vises (c) Indexing heads (d) Rotary Table (e) Fixtures	(4) Read pp. 1722-1739 (7) Read pp. 281-283 & 300 AV 162 AV 169	II. Select and mount work holding device

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
6.13	The student will set up and mill a part to within .001 and square to within 0° 10'.	III. Milling flat surfaces (a) Basic milling principles (b) Conventional milling procedures (c) Climb milling procedures (d) Materials (e) Cutter selections (f) Feeds and speeds (g) Lubricant (h) Safe practice	①Review 279-284 ⑦Read pp. 276-279 ③Projects #17, 19, 39A AV 180	III. Mill a flat surface
6.14	The student will select a cutter and mill a keyway ensuring length of keyway is correct length from radius to radius.	IV. Milling Keyways (a) Types and sizes of keyways (b) Materials (c) Keyway cutters (d) Standards and tolerances (e) Speeds and feeds (f) Lubricants (g) Safe practice	⑦Read pp. 279-281 & 284 ③Project #34 AV 182	IV. Mill keyways
6.15	The student will set-up and drill and bore a hole to specifications and cut a groove.	V. Drill, ream, and bore (a) Types and sizes (b) Materials (c) Index head use and procedures (d) Feeds and speeds (e) Measurements and tolerances (f) Lubricants (g) Safe practices	⑦Read pp. 285-288 ③Project #39-A	V. Drill, ream, and bore holes to specifications

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
6.16	The student will select the type of cutter and cut gears to specifications on print	VI. Perform gear-cutting operations (a) Gear (spur) (b) Rack (c) Bevel (d) Helix	(1) Read pp. 337-360 (7) Read pp. 224-275 (4) Read pp. 717-1042 (3) Project #45-D & 45-F AV 184 AV 185	VI. Mill gears
6.17	The student will mill a slot in a part, followed by a T-slot cutter using standard milling machine practices.	VII. Milling T-slots and dove-tails (a) Types and sizes (b) Materials (c) Feeds and speeds (d) Measurements and tolerances (e) Lubricants (f) Safety procedures	(7) Read pp. 284-285 (3) Project #41-A, 44, 45 AV 168 (2) Progress quiz #20	VII. Mill T-slots and dove-tails
6.18	The student will select at least two (2) cutters of same dia. or different dias. and straddle mill a part using standard milling machine practices.	VIII. Straddle and Gang Milling Operations (a) Types of cutters (b) Cutter spacing (c) Materials (d) Feeds and speeds (e) Angular tolerances (f) Coolants (g) Safety practices		VIII. Perform straddle and gang milling operations
	ABRASIVE MACHINING			
8.1	PRECISION SURFACE GRINDING			
8.18	Student will align work piece in vise zeroing previously milled angular surface with indicator. Mount on magnetic chuck and grind to dimension.	I. Workholding methods (a) Using vise (b) Using fixture (c) Using sine plate	(1) Read pp. 414-415 (7) Read pp. 335-340 (3) Project #34	I. Grind an angular surface

TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
8.114	Dress grind wheel, mount work to angle plate or angle vise and grind work to required tolerance.	II. Grinding perpendicular surfaces (a) Dressing (b) Angle plate (c) Square	⑦Read pp. 340-344 ③Project #41-A ③Project # 39-A ②Progress quiz #20	II. Grind surfaces perpendicular using holding devices
8.3	CYLINDRICAL GRINDING			
8.31	Be able to identify the correct grind wheel by the identification of the code on the wheel. Set grind machine to deliver maximum grind efficiency and maintain the desired finish according to print tolerances.	I. Wheel identification and speeds (a) Code (b) Machine controls (c) Finish	①Read pp. 417-423 ⑥Read pp. 346-348	I. Select the correct wheel and speeds of wheel and table
8.32 and 8.33	Mount wheel to machine and balance on balance ways. Cut off power, remove guards, install wheel, replace covers, start machine, and dress wheel straight and true.	II. Balance ways (a) Master switch (b) Machine controls (c) Guards and safety (d) Switches	①Read pp. 423-434 ⑥Read pp. 73-76	II. Install the wheel, adjust all safety devices, dress, true, and balance the wheel
8.34	Be able to adjust the table for longitudinal taper	III. Dial indicator (a) Test	①Read p. 425 ⑥Read pp. 160-161 ③Project #18-B	III. Adjust longitudinal taper on table
8.35	Traverse table, set wheel infeed to grind part round, straight to specified diameter and finish.	IV. Machine controls (a) Table stops (b) Measuring (c) Gauge	⑥Read pp. 149-155	IV. Traverse grind a straight diameter

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
8.36	Set wheel speed, infeed stops and plunge grind part to specified diameter and finish.	V. Machine controls (a) Infeed stops (b) Wheel speed (c) Measuring gauge	⑥Read pp. 166-168	V. Plunge grind a workpiece
8.37	Set table stops, dress shoulder side of wheel to relieve side pressure and grind part to specified diameter and tolerance.	VI. Machine controls (a) Dressing stick (b) Table stops	⑥Read pp. 156-159	VI. Grind to a shoulder
8.38	Set proper angle on table using sine bar, gauge blocks, and dial indicator. Adjust taper on table to zero reading on dial indicator.	VII. (a) Sine Bar (b) Gauge Blocks (c) Indicator (d) Test material	⑥Read pp. 160-165 ⑥Read pp. 178-181	VII. Traverse grind an external taper
8.39	Adjust centers for zero taper and length of shaft. Lubricate part centers and adjust tail stock center for proper tension.	VIII. (a) Grind dog (b) Extreme pressure lubricant	⑥Read pp. 149-151	VIII. Grind between centers
8.310	Set up work rest and lubricate contact points. Set contact points using a dial indicator to assure no part movement when adjusting the contacts.	IX. (a) Extreme pressure lubricant (b) Table work rests (c) Dial indicator	①Read p. 420 ⑥Read pp. 149-151 ③Project #43-D	IX. Grind long part with work rests
8.312	Adjust work holding fixture and workhead speed. Grind part to specified tolerance and finish	X. (a) Face plate (b) Special fixture (c) Chuck	⑥Read pp. 143-145	X. Set and grind a part on workhead attachments

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TASK CODE	OBJECTIVES	CONTENT OUTLINE	ACTIVITY EXPERIENCE	PERFORMANCE OBJECTIVES
8.5	TOOL & CUTTER GRINDING			
8.510	Select and grind an endmill until sharp and true on sides and end	I. Endmill grinding (a) Type of cutter (b) Position of toothrest (c) Position of micrometer adj. (d) Primary clearance angle (e) Secondary clearance angle (f) Types of fixtures	⑥Read pp. 213-219 AV 202-205 AV 218-222	I. Grind ends and sides of an endmill with cup wheel
8.511	Select and grind a stagger tooth cutter until sharp and true.	II. Staggered tooth grinding (a) Type of cutter (b) Position of toothrest (c) Position of micrometer adj. (d) Primary clearance angle (e) Secondary clearance angle (f) Types of fixtures (g) Inverted "V" tooth rest blade	⑥Read pp. 204-207 ②Progress quiz #22	II. Grind a staggered tooth cutter.
8.6	BENCH AND PEDESTAL GRINDING			
8.61	Select, test and install correct wheel and grind part.	I. Select wheel (a) Type of wheel (b) Test for cracks (c) Correct wheel for material (d) Guards (e) Coolant	⑥Read pp. 77-79 AV 190-191	I. Select the correct wheel and install on grinder and adjust safety devices

* Activity Experience Column: Note 1: The following numbers will indicate textbooks included as suggested texts:

1. Machine Shop Operation and Set-Up - Text
2. Machine Shop Operation and Set-Up - Workbook
3. Machine Shop Project Manual
4. Machinery's Handbook
5. Facts about Tapping
6. Grinding Technology
7. Technology of Machine Tools

Note 2: AV indicates audio-visual numbers which are listed with available source in Chapter VII of the curriculum manual

SUGGESTED TEXTS

1. Machine Shop Operations & Setup
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

2. Machine Shop Operations & Setup Study Guide
   Lascoe, Nelson, Porter
   American Technical Society
   Chicago, Illinois - 4th Ed. - 1973

3. Machine Shop Project Manual
   Program Development
   Department of Community Colleges
   Raleigh, North Carolina - 1977

4. Machinerys Handbook
   Oberg, Jones & Horton
   Industrial Press
   New York - 20th Ed. - 1976

5. Facts About Taps and Tapping
   Greenfield Tap and Die Co.
   Greenfield, Mass. 01301

6. Grinding Technology
   Krar & Oswald
   Delmar Publications
   Albany, New York - 1974

7. Technology of Machine Tools
   Krar, Oswald, Amand
   McGraw-Hill - Gregg Division
   New York - 2nd Ed. - 1977

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Note - Number beside text corresponds to numbering system used in course outline.

MAT 1123

MACHINIST MATHEMATICS introduces gear ratio, lead screw and indexing problems with emphasis on application to the machine shop. Practical applications and problems furnish the trainee with experience in geometric propositions and trigonometric relations to shop problems; concludes with an introduction to compound angle problems.

PREREQUISITE: MAT 1104

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Gear ratio formulas and applications

II. Lead screw

III. Plain indexing and differential indexing

IV. Geometry

V. Trigonometric principles and processes

VI. Problems using the Sine bar

VII. Problems related to gear types

VIII. Problems related to pulleys and power application

IX. Problems related to screw threads

X. Problems related to circular form cutters, cams, gauges, dies, die punches, etc.

XI. Introduction to solid trigonometry (compound angles)

SUGGESTED TEXTS:

Wolfe and Phelps. Practical Shop Mathematics, Vol. I. New York: McGraw-Hill Book Company.

or Slade and Margolis. Mathematics for Technical and Vocational Schools. New York: John Wiley and Sons, Inc.

SUGGESTED REFERENCES:

Axelrod. Machine Shop Mathematics. New York: McGraw-Hill Book Company.

SUGGESTED REFERENCES CONTINUED:

Grazda and Jonsson. Handbook of Applied Mathematics; Third Edition, Princeton: D. Van Nostrand Company.

Palmer and Bibb. Practical Mathematics. New York: McGraw-Hill Book Company.

Abbot, P. Teach Yourself Trigonometry. New York: Dover Publications, Inc.

Schumaker. Vocational Mathematics, Vol. I and II. Chicago: Goodheart-Wilcox Company.

Rusinoff, S. E. Mathematics for Industry. Chicago: American Technical Society.

Wolfe, Mueller, Millikin. Industrial Algebra and Trigonometry. New York: McGraw-Hill Book Company.

WELDING - the various processes used for joining materials by welding are discussed. Lecture demonstrations and practice cover the oxyacetylene and arc welding processes, filler metals used, gases, currents, weldability of metals. Instruction is given in the set-up and safe operation of oxyacetylene welding apparatus. Students prepare joints by both hand and machine cutting with the oxyacetylene torch.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	0	3	1

I. Introduction

II. Setting up and operating equipment

III. Soldering and Brazing

IV. Oxyacetylene welding

V. Cutting

VI. Arc welding

VII. Wire feed operations

VIII. Mechanical testing and inspection

SUGGESTED TEXTS:

Althouse, Andrew D., Turnquist, Carl H. and Bowditch, William A. Modern Welding. Homewood: The Goodheart-Willcox Co., Inc., 1965.

Griffin, Ivan H. and Roden, Edward M. Basic Tig Welding. Albany, New York: Delmar Publishers, Inc.

Giachino, J. W., Weeks, William and Brune, Elmer. Welding Skills and Practices. Chicago: American Technical Safety

Jefferson, T. B. The Welding Encyclopedia. Morton Grove, Illinois: Welding Engineer Publications, Inc.

Sacks, Raymond J. Theory and Practice of Arc Welding; Second Edition. Princeton, N.J.: D. Van Nostrand Co., Inc.

Stieri, Emanuele. Basic Welding Principles. Englewood Cliffs, N.J.: Prentice Hall, Inc.

PHY 1111

APPLIED SCIENCE, an introduction to physical principles and their application in industry. Topics in this course will support the particular curriculum in which the course is offered and will be selected from the following: measurement, force, motion, work, energy, power, solids, liquids, gases, heat, thermometry, electrical principles, properties of matter, sound, and light.

PREREQUISITE: None.

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	2	4

I. Units of Measurement

II. Development and Use of the "Scientific Method"

III. Principles and Applications: (to be selected from the following)

A. Properties of Materials
B. Mechanics
C. Heat
D. Light and Sound
E. Electricity and Magnetism

SUGGESTED REFERENCES:

Olivio, C.Thomas. Fundamentals of Applied Science. Albany: Delmar Publishers, 1964.

Dull, Charles E., Metcalfe, H. Clard, and Brooks, William O. Modern Physics. New York: Holt, Rinehart & Winston Company.

Efron, Alexander. Basic Physics. New York: John F. Rider Publishing Company, 1958.

Harris, Norman C. and Hemmerling, Edwin M. Introductory Applied Physics. New York: McGraw-Hill Book Company, Inc.

White, Harvey E. Physics, An Exact Science; Latest Edition. Princeton: D. Van Nostrand Company, Inc.

INDUSTRIAL ORGANIZATIONS - methods, techniques, and practices of modern management in planning, organizing and controlling operations of a manufacturing concern. Introduction to the competitive system and the factors constituting product cost.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. The industrial organization--its nature and structure

II. Industrial ownership

III. Industrial finance: Capitalization of the enterprise

IV. Physical facilities

V. Materials control

VI. Production control

VII. Quality control from the management's viewpoint

VIII. Administration of wage and salary

IX. Sales and advertising

X. Financial controls

SUGGESTED TEXT:

Bethel, Lawrence L.; Atwater, Franklin S.; Smith, George, H.E.; and Stackman, Harvey A., Jr., Essentials of Industrial Management; Latest Edition. New York: McGraw-Hill Book Company, Inc.

SUGGESTED REFERENCES:

Bethel, LawrenceL.; Atwater, Franklin S.; Smith, George H.E.; Stackman, Harvey A., Jr; and Riggs, James L.; Industrial Organization and Management; Latest Edition. New York: McGraw-Hill Book Company, Inc.

MACHINE REPAIR, this course is designed to acquaint the student with the movable parts of machine tools, the basic methods of joining these parts together, adjustments necessary to obtain satisfactory service, removal and replacement of worn parts, uses of lubricants as applied to machine tools, and safety precautions as directed by OSHA.

PREREQUISITE: None.

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	2	3	3

I. Basic machine construction

II. Adjustments

III. Removal and replacement of worn parts

IV. Lubricants

V. Safety

SUGGESTED TEXTS:

Equipment Instructions Manual, Machinery's Handbook and Technical Manuals.

SMALL BUSINESS OPERATIONS - an introduction to the business world, problems of small business operation, basic business law, business forms and records, financial problems, ordering and inventorying, layout of equipment and offices, methods of improving business, and employer-employee relations.

PREREQUISITE: None

	Class Hours	Lab Hours	Credit Hours
MAJOR DIVISIONS	3	0	3

I. Introduction

II. Problems of small business operation

III. Basic business law

IV. Business forms and records

V. Financial problems

VI. Location problems

VII. Ordering and inventorying

VIII. Layout

IX. Improving your business

X. Employer-employee relations

SUGGESTED TEXT:

New York State Vocational and Practical Arts Association Publication. Small Business Management. Albany: Delmar Publishers, Inc., 1952.

Chapter V

EQUIPMENT

The equipment listed has been identified as being necessary to begin a machinist program for 15 students. As funds and additional space become available, other items of equipment can be added to provide students with advanced skills. While requisition of equipment is now a local concern, the high cost of new equipment suggest utilizing whatever resources might be available to acquire used machine tools. Potential sources of used machine tools includes state and federal surplus, industry, Equipment Procurement Section of the Department of Community Colleges, equipment sales companies and other educational institutions.

Maintenance and repair of equipment and availability of supplies are concerns that require a continuing budget and the attention of the institution. Used equipment may be traded for other equipment under very restrictive conditions. The Equipment Procurement Section of the Department of Community Colleges can be helpful in assuring the necessary requirements are met and should be notified if a trade is being considered.

Procedures for securing and disposing of surplus equipment are available from the Equipment Procurement Section of the Department of Community Colleges.

Basic Machine Shop Equipment

15 Students

ITEM NO.	QUANTITY	DESCRIPTION
		Machine Tools
1	4	Lathes, 15" X 42", complete with accessories
2	1	Lathe, 16" X 24", Heavy duty.
3	1	Lathe, under 10" for spud lathe.
4	2	Bridgeport Milling Machine and accessories or equivalent.
5	1	Milling Machine, Universal Horizontal and accessories.
6	1	Drill Press, 1/2" cap. Floor type
7	1	Drill Press, Radial
8	1	Grinder with pedestal base 2-10" wheels
9	2	Grinder with pedestal base 2-8" wheels
10	1	Surface Grinder, 6" wheel 6" X 18" magnetic chuck
11	1	Belt Grinder
12	1	Cylindrical Grinder, 10 X 20" with attachments
13	1	Horizontal Metal Cutting Band Saw
14	1	Do-All Contour Matic-Hydraulic Band Saw with accessories.
		Machine Tool Accessories
15	1 pr.	Parallels, 12" X 1" X 2".
16	1 pr.	Parallels, 6" X 1/2" X 1"
17	1 pr.	Parallels, 6" X 3/8" X 1/2"
18	1 pr.	Parallels, 6" X 3/8" X 3/4"
19	1 pr.	Parallels, 6" X 1/4" X 1/2"

ITEM NO.	QUANTITY	DESCRIPTION
20	1 pr.	Parallels, 6" x ¼", 3/8".
21	1 pr.	V-Blocks
22	4	Drill Press Vises.
23	2 ea.	Lathe Dogs, Size ½", 3/4", 1", and 1½".
24	2	Float-Lock Vises.
25	6	Drill Sleeves, 2 M.T. to 3 M.T.
26	1	Drill Sleeves, 1 M.T. to 2 M.T.
27	1	Drill Sleeves, 2 M.T. to 4 M.T.
28	2	Ball Bearing Lathe Center, heavy duty.
		Measuring and Gauging Tools
29	1	Hardness Testing Equipment
30	1	Surface Plate 24" x 36" - Grade A.
31	2	Universal vernier caliper with case.
32	1	Universal Bevel Protractor.
33	2	Stell Protractors
34	2	Master Vernier Height Gauge, 12".
35	1	Vernier Depth Gauge.
36	1	Carbide Scriber for Height Gauge.
37	1	Combination Sets, 12".
38	4	Steel Squares, 17".
39	2	Magnetic Base Indicator Holder with swivel post.
40	2	Wigglers or Center Finders.
41	1 ea.	Dividers, Sizes 8", 10", 12" with spring nut.
42	1	Machinist Level.
43	1 set	Small Hole Gauges.

ITEM NO.	QUANTITY	DESCRIPTION
44	1 set	Telescoping Gauges ½" to 6".
45	1	Screw Pitch Gauge, 4 to 80.
46	1	Feeler Gauge.
47	1	Drill Gauge for A to Z drills.
48	1	Drill Gauge for 1/16" to ½" drills.
49	1	Drill Gauge for 1 to 60 drills.
50	1	Drill Point Gauge.
51	1	Surface Gauges.
52	1	29 degrees Screw Thread Gauge.
53	1 set	Radius Gauge Set.
54	1	Dial Indicator.
55	1	Inside Micrometer, 1½" to 12".
56	1	Depth Micrometer.
57	6	Outside Micrometers, 0" to 1".
58	2	Outside Micrometers, 1" to 2".
59	1	Angle Plate
60	2	C-Clamps, no twist.
		Hand Tools
61	1	½" Hand Drill
62	1	Arbor Press.
63	3	Tap Wrenchs (one each size).
64	1 set	Punches
65	1	Hacksaw Frame
66	1 set	Screw Plates (Dies, taps, stocks & handles)
67	2	6" Adjustable Wrench.

ITEM NO.	QUANTITY	DESCRIPTION
68	2	8" Adjustable Wrench.
69	2	12" Adjustable Wrench.
70	1	18" Adjustable Wrench.
71	3	4" Machinist Bench Vises
72	2	Ball Peen Hammers, 8 oz.
73	1	Ball Peen Hammers, 1 lb.
74	1	Grease Gun
75	1	Wheel Dresser, Diamond Hand Tool.
76	1	¼" Drill.
77	1	Heat Treatment Equipment, Elec. & Gas.
		Safety Items
78	2	Face Shield for grinding, depth 6".
79	1	Lens Cleaning Station.

Chapter VI

RESOURCES

Selected resources for the machinist curriculum are listed in the categories of audiovisuals, texts, industrial and educational publications and other available resources.

The audiovisual resources are keyed by reference number to the activity/experience column. They are organized by topic with reference number, title and source of the film given. For more information the instructor should contact the source.

The suggested texts and resources list books available to support the overall instructional program. These are instructional materials currently in use or recommended by instructors teaching in the machinist program.

The industrial publications listed provide a reference source of specialized technical content related to the machinist trade. The educational publications listed provide additional instructional materials.

The other available resources listed include films available from the National Audiovisual Center, Washington, DC. Also included is information on self-instructional materials, slide-tape presentations and unit tests available from the Sanford (Central High School, Sanford, NC) Project and the South Carolina Career Cluster Project for Machine Shop (Occupational Resource Unit, State Department of Education, Columbia, SC).

Audiovisual Resources

Orientation

	Title	*Source
1.	Careers in Machine Shop Tech	NTDPMA
2.	Introduction to Metal Shop	RMI
3.	Crib Foremens Assignment	RMI
4.	Metal Shop Safety	RMI

Basic Hand Tools

	Title	*Source
5.	Bench Metal Work	RMI
6.	Fundamentals of Filing	NAC
7.	Filing	BFA
8.	Hammers	BFA
9.	Point 3 Chisels	NAC
10.	Wrenches	BFA
11.	Screw Drivers	BFA
12.	Pliers	BFA
13.	Hack Saws	BFA
14.	Band Sawing Sheet Metal	BFA
15.	Point 6 Hack Saws	NAC
16.	Scribing Parallel to An Edge	McG-H
17.	Using the Center Punch	McG-H
18.	Layout of Radii	McG-H
19.	Using Abrasive Cloth for Hand Polishing	McG-H
20.	Filing an Edge Square	McG-H
21.	Using the Hacksaw	McG-H

Basic Hand Tools (con't)

	Title	*Source
22.	Special Use of Hacksaw	McG-H
23.	Tapping a Hole	McG-H
24.	Cutting External Threads	McG-H
25.	How to Hand Ream a Hole	McG-H
26.	Layout a Line with Surface Gauge	McG-H
27.	How to Read a Micrometer	McG-H
28.	How to Read a Vernier Scale	McG-H
29.	How to Read a Vernier Scale	McG-H
30.	The Steel Scale	BFA
31.	Measure O.D. of Object with Scale	Sanford
32.	Measure O.D. and I.D. of Object with Caliper Rule	Sanford
33.	Transfer Measurement with Dividers	Sanford
34.	Scribe Lines at Angles, Center Round Stock with Combination Square Set	Sanford
35.	Scribe Parallel Lines, Transfer Measurement, Finds Center with Hermaphrodite Calipers	Sanford
36.	Scribe and Measure Line on a Vertical Surface Using Surface Gauge	Sanford

Vernier Measurement

	Title	*Source
37.	Vernier Caliper	BFA
38.	Reading the Vernier Scale	Thorne
39.	The Vernier Caliper at Work	Thorne
40.	Dial Indicator	Thorne
41.	Measure Height, Thickness, Length, Width, and ID and OD of Stock Using a Vernier Gauge and Surface Plate	Sanford

Vernier Measurement (con't)

	Title	*Source
42.	Check the Accuracy of Dial Indicator Using Precision Gauge Blocks	Sanford
43.	Test the Concentricity of Round Stock Using a Dial Indicator and V Blocks	Sanford

Micrometer Measurement

	Title	*Source
44.	Main Parts	Starrett
45.	How to Handle	Starrett
46.	Screw Thread Principle	Starrett
47.	Reading in Thousandths	Starrett
48.	Reading in 3 Steps	Starrett
49.	Reading in Ten Thousandths	Starrett
50.	Proper Care	Starrett
51.	Test on Reading	Starrett
52.	Common Tools	SPMX
53.	Types of Micrometers	SPMX
54.	Decimal Equivalents	SPMX
55.	Using a Micrometer	Thorne
56.	The Depth Gauge and Inside Micrometer	BFA
57.	3 Diameter Work Piece (Decimal)	BCTI
58.	Measure Diameter of Rod, Thickness of Sheet Metal and Length of Rods Using an Outside Micrometer	Sanford
59.	Contact Measures - The Diameter of Tubing Using Inside and Outside Spring Calipers Transferring the Measurements to Inside and Outside Micrometers	Sanford
60.	Measure the ID of Tubing with Telescope Gauge	Sanford
61.	Measure the Depth of Holes Using a Depth Micrometer	Sanford
62.	File to Scribed Lines on Different Metals, Using the Proper Files	Sanford

Micrometer Measurement (con't)

	Title	*Source
63.	Cut Metals Using Cold Chisels and Metal Cutting Hand Saws	Sanford
64.	Layout Points for Drilling and Lines for Milling and Turning Using the Necessary Layout Tools	Sanford
65.	Threading Stock Using Dies and Diestock	Sanford
66.	Threading Holes Using Taps and Tap Handles	Sanford
67.	Polish Parts, Using Abrasive Cloth, Lapping Compound, and Steel Wool	Sanford
68.	Inspects Finished Parts, Using Scales, Gauges and Surface Plate	Sanford

Band Saws

	Title	*Source
69.	Welds Bandsaw Blades, Using Weld Attachment on Vertical Saw	Sanford
70.	Cuts Stock Using the Horizontal Bandsaw	Sanford
71.	Cuts Stock at Angles Using the Horizontal Bandsaw	Sanford
72.	Cuts Contours, Circles and Straight Lines, Using the Vertical Bandsaw	BCTI

Quality Control

	Title	*Source
73.	Basic Inspection Instrument and Methods	NTDPMA
74.	Optical Comparator	BCTJ

Drill Press Operations

	Title	*Source
75.	Drill Press	BFA
76.	Sensitive Drill Press	NAC

Drill Press Operations (con't)

	Title	*Source
77.	Drill to a Layout and Spot Face	NAC
78.	C Sink and C Bore	BFA
79.	Drilling Steel	BFA
80.	Soft Metal	BFA
81.	Let's Take a Better Look at the Drill Press	McG-H
82.	Counter Sinking	McG-H
83.	Starting a Small Tap Squarely	McG-H
84.	Drilling in Round Stock	McG-H
85.	Make Setups for Drilling Round Stock, Flat Stock, Sheet Metal and Irregular Shapes Using Proper Holding Devices	Sanford
86.	Change the Holding Capacity of the Drill Press Spindle Using Sockets, Sleeves, Chucks	Sanford
87.	Drill Holes in Different Types of Metals Using the Proper Feed and Speed	Sanford
88.	Drill Holes to Different Depths Using the Drill Press Stop	Sanford
89.	Countersink , Counterbore , and Spot Face Drill Holes Using the Proper Tool and Controlling Depth	Sanford
90.	Drill Angular Holes Using Table Adjustments	Sanford
91.	Drill Undersize Holes and Enlarges Using Reamers	Sanford
92.	Tap Holes Using Taps and Tapping Attachment	Sanford
93.	2 x 2 Block	BCTI

Engine Lathe

	Title	*Source
94.	Carriage and Feed Operations	McG-H
95.	Power Train	McG-H

Engine Lathe (con't)

	Title	*Source
96.	Personnel Safety and Machine Care	McG-H
97.	Removing and Replacing Chuck	McG-H
98.	Tail Stock	McG-H
99.	Facing Work	McG-H
100.	Turning a Diameter Using Micrometer Dial	McG-H
101.	Drilling with a Lathe	McG-H
102.	Drilling a Center Hole	McG-H
103.	Drilling and Reaming a Hole	McG-H
104.	Measuring Longitudinal Cuts	McG-H
105.	Filing and Polishing	McG-H
106.	Starting a Tap	McG-H
107.	Starting Threads with a Die	McG-H
108.	Dial Indicator	Thorne
109.	Adjusting a 4-Jaw Chuck	Ealing
110.	Lathe Turning With 4-Jaw Chuck	Doubleday
111.	Engine Lathe - Part I	RMI
112.	3 Diameter Work Piece (Fractional)	BCTI

Engine Lathe (Secondary)

	Title	*Source
113.	Engine Lathe Part II	RMI
114.	Reaming on a Lathe	Doubleday
115.	Boring on a Lathe	Doubleday
116.	Boring on a Lathe	Doubleday
117.	How to Knurl on a Lathe	Doubleday
118.	How to Drill on a Lathe	Doubleday

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Engine Lathe (Secondary) (con't)

	Title	*Source
119.	Cutting Feeds and Speeds	Doubleday
120.	Secondary Cutting Operations	NTDPMA
121.	Knurling	McG-H
122.	Using a Parting Tool	McG-H
123.	Standard Alignment of Centers	McG-H
124.	Precision Alignment of Centers	McG-H
125.	Setting Work Between Centers	McG-H
126.	Setting Up a Steady Rest	McG-H
127.	Boring a Hole	McG-H
128.	Single Point Cutting Tools	NAC
129.	Single Point Cutting (Side and End)	NAC
130.	Measuring with a Small Hole and Telescope Gauge	Thorne
131.	Clean and Mount Chucks Using Thread Cleaner and Cradle	Sanford
132.	Determine the Proper Feed and Speeds For the Type Lathe Operations and Materials	Sanford
133.	Perform Facing, Turning, Parting, Chamfering, Square and Fillet Shoulders Using 3-Jaw Chuck	Sanford
134.	Adjust Tail Stock for Drilling Operations	Sanford
135.	Perform Lathe Operations Using a Dial Indicator and 4-Jaw Chuck	Sanford
136.	Turn Tapers Using the Compound Offset Tailstock and Taper Attachment	Sanford
137.	Taper Turning (Offset)	Ealing
138.	Taper Turning (Attachment)	Ealing
139.	Taper Turning Between Centers	Thorne
140.	Turning a Step Using Compound	Thorne
141.	Turning a Taper Using Offset Method	McG-H

Engine Lathe (Secondary) (con't)

	Title	*Source
142.	Cutting a Taper Using the Compound Rest	McG-H
143.	Cutting a Taper with Compound and Taper Attachment	NAC
144.	Center	BCTI
145.	Hammer (Ball Peen)	BCTI
146.	Hammer (Soft Face)	BCTI

Engine Lathe (Thread)

	Title	*Source
147.	Cutting an External Thread	NAC
148.	Cutting a Thread	McG-H
149.	Thread Cutting	NTDPMA
150.	Thread Shaft	BCTI
151.	Clamp Screws	BCTI
152.	Turret Lathe Operations - Part 1	BCTI
153.	Turret Lathe Operations - Part 2	BCTI
154.	Facing Turning Boring on VTL	NAC

Milling Machines (Vertical)

	Title	*Source
155.	Operate Vertical Milling Machine	RMI
156.	Milling Machines	VIMC
157.	Vertical Mill	VIMC
158.	Power Feeds	VIMC
159.	Selecting Proper Cutters for the Material and Type Milling	Sanford
160.	Clamp Assorted Work Pieces to the Milling Machine Table Using Necessary Holding Devices	Sanford

Milling Machines (Vertical) (con't)

Title	*Source
161. Holding Devices	Sanford
162. True Work Piece Using Dial Indicator in Spindle	Sanford
163. Adjust Feeds and Speeds for Types of Cut and Material	Sanford
164. Using Proper Cutting Tools	Sanford
165. Square Stock Using End Mills	Sanford
166. Mill Key Ways Using Woodruff Key Seat Cutters	Sanford
167. Cut Dovetails Using End Mills	Sanford
168. Mill Angles, Using Swivel, Universal and Other Holding Devices	Sanford

Milling Machines (Horizontal)

Title	*Source
169. Horizontal Milling Machines	VIMC
170. Select Proper Cutters for the Material and Type Milling	Sanford
171. Select , Install and Remove Setups on the Mill, Using the Necessary Arbors, Collets, Holders and Adapters	Sanford
172. Clamp Assorted Work Pieces on the Milling Machine Table Using Necessary Holding Devices	Sanford
173. Determine the Proper Feed and Speed for the Type of Milling Operations and Material	Sanford
174. Using a Dial Indicator	Sanford
175. Mill a Flat Surface Using a Cylindrical Cutter	Sanford
176. Face a Surface Using a Face Milling Cutter	Sanford
177. Reduce Rectangular Stock to Specific Dimensions, Retaining Its Squareness Using Parallels, Squares and Holding Devices	Sanford
178. Mill Bevels Using Bevel Blocks and Universal Vise	Sanford

Milling Machines (Horizontal) (con't)

Title	*Source
179. Mill Flat Surfaces on Square, Hex, Octagon, Polygon Stock	Sanford
180. Square Stock Using Straddle Mill Technique	Sanford
181. Mill Keyways Using End Cuttering Mills, Dovetails, T Slots, Angle	Sanford
182. Cut Using Appropriate Cutters	Sanford
183. Cut Spur Gears Using Index Head	Sanford
184. Contour Face Milling	NAC

Grinding (Pedestal)

Title	*Source
185. Grinder Buffer	BFA
186. Dressing Wheel	BFA
187. Grinder Buffer, Buffing	BFA
188. Select and Adjust, Change Wheels	Sanford
189. Dressing Wheels for Normal and Shaped Grinding Using Dresser	Sanford

Grinding (Drill)

Title	*Source
190. Twist Drill	NTDPMA
191. Sharpen Drill Bit Using Drill Bit Grinder	Sanford
192. Sharpen Drill Bit	BCTI

Grinding (Tool Bit)

Title	*Source
193. Single Point Cutting Tool	NTDPMA
194. How to Grind a Right Hand Turning Tool	Doubleday

Grinding (Tool Bit) (con't)

Title	*Source
195. Tool Grinding - Turning Tool	BCTI

Grinding (Surface)

Title	*Source
196. Select and Change Grinding Wheel	Sanford
197. Dress Grind Wheel Using a Diamond Tip Dresser	Sanford
198. Clamp Work Piece Using Magnetic Chuck	Sanford
199. Grind Work Piece to Size	Sanford

Grinding Tool Cutter

Title	*Source
200. Tool and Cutter Grinder, Part 1	DCA
201. Tool and Cutter Grinder, Part 2	DCA
202. Tool and Cutter Grinder, Safety	DCA
203. Tool and Cutter Grinder, Basic Operation	DCA

Grinding (Tool Post)

Title	*Source
204. Operation of Dumore Tool Post Grinder	BCTI

Shaper

Title	*Source
205. How to Operate the Shaper	RMI
206. Install Work Piece on Shaper Table Using a Vise or Suitable Holding Device	RMI
207. True the Work Piece and Vise Using a Dial Indicator	Sanford

Shaper

Title	*Source
208. Select and Install Cutting Tool	Sanford
209. Adjust the Stroke for Size of Workpiece	Sanford
210. Determine the Appropriate Speed and Feed for the Type of Operation and Material	Sanford
211. Make Vertical Cuts Using Roughing and Finish Tool	Sanford
212. Make Horizontal and Dovetail Cuts Using Right and Left Hand Tool Bits	Sanford
213. Make Angular Cuts Using Rough and Finish Tools	Sanford
214. Make Stopped Cuts for Blind Slots and Grooves	Sanford

Others

Title	*Source
215. Oxyacetylene Welder	RMI
216. Brazing Carbide Tools	NAC
217. Carbide Cutting Tools	NAC
218. Cutting with Carbide Tools - Single Pt.	NAC
219. Cutting with Carbide Tools - Milling Cutters	NAC
220. Grinding Carbide Cutting Tools	NAC
221. Metal Spinning Work	RMI
222. Sheet Metal Work	RMI
223. Forming Copper Layout	BFA
224. Forming Copper Stretch Forming	BFA
225. Forming Copper Raising	BFA
226. Forming Copper Planishing	BFA
227. Forming Copper Polishing	BFA
228. Broaching an Internal Keyway	NAC

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Others (con't)

Title	*Source
229. Care and Maintenance of Tapered Bearings	NAC
230. Oxyacetylene Welding Equipment	BFA
231. Oxyacetylene Welding Torch Technique	BFA
232. Oxyacetylene Welding Flame Cutting	BFA
233. Oxyacetylene Welding Joining Steel	BFA
234. Precision Measurement the Combination Square	BFA
235. Power Hack Saw and Bank Saw	BFA

*See page 148 for source information

Code	Source
BFA	BFA Educational Methods 2211 Michigan Avenue Santa Monica, California 90404
Doubleday	Doubleday Multi-Media P.O.Box 11607/1371 Reynolds Avenue Santa Ana, California 92705
Ealing	Ealing Film Loops Cambridge, Mass. 02140
NAC	National Audiovisual Center Washington, DC 20409
NTDPMA	National Tool & Die & Precision Machining Ass'n 9200 Livingston Road Washington, DC 20022
McG-H	McGraw Hill Films 1221 Avenue of the Americas New York, New York 10020
RMI	RMI Educational Films 701 West Port Road Kansas City, Missouri 64111
Sanford	Sanford High School Sanford, NC 27330
VIMC	Valiant I.M.C. 237 Washington Avenue Hackensack, NJ 07602
Starrett	L.S. Starrett Tool Company Athol, Mass. 01331
Thorne	Thorne Films, Inc. 1229 University Avenue Boulder, Colo. 80302
BCTI	Beaufort Co. Technical Institute Washington, NC 27889
DCA	DCA Educational Products Philadelphia, PA 19144

Suggested Texts and Resources

Metalworking Handbook: Principles and Procedures
Adams
Arco Publishing Company, Inc.
219 Park Ave. South
New York, NY 10003

Machine Tool Operation, Part I.
Burghardt, Henry D.; Axelrod, Aaron; and Anderson, James
New York: McGraw-Hill Book Company, Inc., 1960

Shaper Set Ups
Cincinnati, Ohio: The Cincinnati Shaper Company

Treatise on Planers
Cincinnati: Cincinnati Planer Company

Handbook for Drillers
Cleveland: Cleveland Twist Company

American Machinist's Handbook
Colvin, F. H., Stanley and LeGrand
New York: McGraw-Hill Book Company, Inc., 1955

Grinding Practice
Colvin, F. H. and Stanley
New York: McGraw-Hill Book Company, Inc.

Tool Design - 3rd Edition
Donaldson, Lecon, Goold.
McGraw-Hill Copyright 1973

Machine Shop Technology
Felker, C.A.
Milwaukee, Wisconsin: The Bruce Publishing Company, 1952

Milling Machine Indexing
Felker and Paine
Milwaukee: The Bruce Publishing Company

Interpreting Engineering Drawings
Jensen & Hines
Delmar Publishers
1972 Edition

Machine Shop Training Course, Vols. I and II
Jones, Franklin D.
New York: The Industrial Press

Drilling Technology
Krar & Oswald
Delmar Publishers
Albany, NY 1977

Machine Shop Operations
Krar - Oswalt - St. Amand
McGraw-Hill Ryerson Ltd.
New York 1975

Metalworking Technology
Richard L. Little
McGraw-Hill Copyright 1977

Turret Lathe Operator's Manual
Longstreet and Bailey
Cleveland: The Operator's Service Bureau of the Warner and Swasey Company

Programming for Numerical Control Machines
Roberts & Prentice.
McGraw-Hill Copyright 1968

Machine Shop Work
Shuman
Chicago: American Technical Society

Mathematics for Machine Technology
Robert D. Smith
Delmar Publishers
Albany NY 1974

Machine Shop Safety Workbook
Thomas Wasiloff
McGraw-Hill, Inc.

Machine Shop Skill Manuals: (3 volumes)
Thomas Wasiloff
American Technical Society
Chicago, IL 60637 1976

Machine Tools and Machining Practices (Manufacturing Technology Series)
Vol. I and II
White, Neely, Kibbe, Meyer
Wiley Publication Copyright 1977

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Basic Instructional Units for the Machine Trades
Instructional Materials Lab, T & I Ed. 1958
Ohio State University, Columbus, Ohio 43210

Basic Precision Machining
National Tool, Die and Precision Machining Assn.
9300 Livingston Road, Washington, DC 20022 (5050)

Basic Training Guide to the New Metrics & SI Units
National Tool, Die & Precision Mathining Assn.
Washington, DC

Curriculum Materials for Machine Shop

MS-257	Basic Concepts in Numerical Control
MS-234	Electrical Discharge Machining
DR-160	Exploratory Drafting-Machine Shop
MS-55	Exploratory Machine Shop
EN-425	Glossary of Key Words - Machine Shop
MS-93	Machine Shop Operation - 1
MS-434	Machine Shop Operation - 2
MS-58	Mathematics I - Machine Shop
MS-806	N/C Tape Preparation for Flexowriter
MS-56	Precision Inspection Manual I
MS-57	Precision Inspection Manual II
MS-53	Strength of Materials - Machinists
MS-54	Theory I - Machine Shop

New Jersey Vocational-Technical Curriculum Laboratory
Rutgers - The State University, Building 4103
Kilmer Campus, New Brunswick, NJ

Facts About Taps & Tapping
Greenfield Tap & Die Company
Greenfield, Mass. 01301

Grinding Wheels - Standard Stock & Specifications Manual
Norton Grinding Wheel Division
Worcester, Massachusetts 01606

Grind Wheels - Stock Catalog
Bay State Abrasives
Westboro, Massachusetts 01581

Handbook of Meehanite Metals
Builders Iron Foundry
Providence, Rhode Island

Hand Tools for Metalworking Trades
Instructional Materials Center
University of Texas at Austin
Austin, TX 78712 1972

Jigs & Fixtures Learner's Manual
Instructional Materials Laboratory
Ohio State University
1885 Neil Avenue, Columbus, Ohio 43210 1973

Machine Shop
Oklahoma State Dept. Vocational & Technical Education
Curriculum & Instructional Materials Center. 1972
1515 West Sixth Avenue, Stillwater, Oklahoma 74074

Machine Shop Theory
National Tool, Die and Precision Machining Assn.
9300 Livingston Road, Washington, DC 20022 (5011)

Machine Shop: Suggested Basic Course Outline
Vocational Instructional Services
Vocational Industrial Education
Texas A & M University. 1970

Machine Tool Series
Volume I - Measurements
Volume II - Basic Hand Tools
Volume III - Work Planning & Setup
Volume IV - Fundamentals of Metal Cutting
Volume V - Milling & Lathe Cutting Tools
Volume VI - Twist Drills & Grinding Wheels
Educational Methods
500 North Dearborn Street
Chicago, IL 60610

Machine Trades: A Suggested Course Outline
Instructional Materials Lab, T & J Ed. 1974
Ohio State University, Columbus, Ohio 43210

Machine Trades I, Learner's/Instructor's Manual
Instructional Materials Lab, T & I Ed. 1965
Ohio State University, Columbus, Ohio 43210

Machine Trades II, Learner's/Instructor's Manual
Instructional Materials Lab, T & I Ed. 1971
Ohio State University, Columbus, Ohio 43210

Machinist: Supervised Study Guide for Related Instruction/
Assignment Tests & Answer Book (Three volumes).
Texas Trade & Industrial Education Series
Instructional Materials Services
Division of Extension
The University of Texas at Austin, Austin, TX 78712. 1975

Machinist Course 44E 10
Cluster 1: Introduction, Hacksawing, Filing, Polishing
Cluster 2: Shop Drawings, Layout a Workpiece
Cluster 3: Bench Grinder, Chisels, Punches
Cluster 4: Drills, Lubricants & Coolants, Drilling
Cluster 5: Threading, Removing & Replacing Threaded Fasteners
Cluster 6: Metals, Supplies & Equipment, Cut-Off Saws
Cluster 8: Maintenance, Lathe Operations
Cluster 9: Machining Square Grooves Parting
Cluster 10: Turning Radii
Cluster 11: Knurling, Drilling, Boring, Reaming
Cluster 12: Tapers
Cluster 13: Taper Turning & Boring with Compound Rest
Cluster 17: Cylindrical & Comcal Grinding
Cluster 21: Gap Lathe, Milling Fixture
Cluster 22: Versa-Mil, Cutters, Indexing, Keyway Milling
Training Material Support Branch, Logistics Support Directorate
U. S. Army Ordinance Center and School
Aberdeen Proving Ground, Maryland 21005

Machinist MOS 44E, Soldier's Manual Skill Level One/Two/Three (Two volumes)
Headquarters, Department of the Army
Washington, DC. Field Manual No. 9-44E 1/2/3. 1976

Machinist Skill Development Base Course MOS-None
Program of Instruction for 702-44E 20-I
U. S. Army Ordinance Center and School
Aberdeen Proving Ground, Maryland 21005. 1969

Manufacturing & Related Task Inventories/Strategies for Curriculum
Instructional Materials Laboratory
Ohio State University
1885 Neil Avenue, Columbus, Ohio 43210

Matched Tool & Die Steels
Carpenter Steel Company
Reading, Pennsylvania 19603

Metalworking Handbook: Principles & Procedures
Arco Publishing Company, Inc.
219 Park Avenue South, New York, NY 10003

Occupations in Metalworking, Review and Analysis of Curricula for
ERIC Clearinghouse on Vocational and Technical Education
Center for Vocational and Technical Education
Ohio State University, 1900 Kenny Road, Columbus, OH 43210 1970

Product Manual - Tool & Die Steels
Latrobe Steel Company
Latrobe, Pa.

Properties and Identification of Metal and Heat Treatment of Steel
Special Text ST9-187
U.S. Army Ordinance Center and School
Aberdeen Proving Ground, Maryland 21005. 1974

Shop Drawings. Special Text ST 9-166
U. S. Army Ordinance Center & School
Aberdeen Proving Ground, Maryland 21005. 1976

Time Free Modular Competency Based Curriculum:
Machine Shop Operations - Initial
Machine Shop Operations - Intermediate, A & B
Machine Shop Operations - Final
Machine Shop Operations - Instructional Resources
Link Educational Laboratories
Montgomery, Alabama 36111. 1974

Training Handbook
National Tool, Die and Precision Machining Assn.
9300 Livingston Road, Washington, DC 20022 (5022)

Welding Stainless Steel
Armco Steel Company
Middletown, Ohio

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Films
Available From The
National Audiovisual Center
Washington, DC

Brazing Carbide Tools, 16mm film, Agency OE 241
Charging And Operating A Cupola, 16mm film, Agnecy No. OE 437
Endfeed Grinding A Tapered Pin, 16mm, Agency OE 089
Facing, Turning, Boring, Grooving And Chamfering - On A Vertical Turrent Lathe, 16mm film, Agency No. OE 018
Fine Grinding And Polishing, 16mm film, Agency No. MNO2449K
Hobbing A Helical Gear - Two Cuts Nondifferential Method, 16mm, Agency No. OE 235
Hobbing A Spur Gear, Pt. 1, Setting Up The Change Gears, 16mm film, Agency No. OE 231
Hobbing A Spur Gear, Pt. 2, Setting Up And Hobbing the Work, 16mm, Agency No. OE 232
Hobbing A Square Tooth Spline Shaft, 16mm film, Agency No. OE 233
Safety For Sure, 16mm, Agency No. T431
Setting Up And Machining Bar Stock, 16mm, Agency No. OE 215
Shop Safety, 16mm, Agency No. TF90-3790
Supervisor As A Leader, The, Pt. 1, 16mm film, Agency No. OE 168
Supervisor As A Leader, The, Pt. 2, 16mm film, Agency No. OE 169
Thrufeed Grinding A Straight Pin, Pt. 1, 16mm film, Agency No. OE 085
Thrufeed Grinding A Straight Pin, Pt. 2, 16mm film, Agency No. OE 086
Compression Molding, Pt. 1. Preparing the Charge And Loading The Mold, 16mm film, Agency No. OE 468
Compression Molding, Pt. 2, Molding A Simple Part, 16mm film, Agency No. OE 469
Every Minute Counts, 16mm film, Agency No. OE 61
Maintaining Workers' Interest, 16mm film, Agency No. OE 159
New Supervisor Takes A Look At His Job, A, 16mm film, Agency No. OE 150
Planning and Laying Out Work, 16mm film, Agency No. OE 151
Safety In The Shop, 16mm film, Agency No. OE 157
Supervising Workers On The Job, 16mm film, Agency No. OE 157
Molding A Valve Body, 16mm, Agency No. OE 430
Molding With A Loose Pattern-Bench, 16mm film, Agency No. OE 423
Molding With A Loose Pattern-Floor, 16mm film, Agency No. OE 428
Molding With A Split Pattern, 16mm Agency #OE 426
Molding With A Three Part Flask, 16mm film, Agency No. OE 432
Planetary Gears, Principles Of Operation, Pt. 1, Single Sets, 16mm Agency No. TF09-1855
Planetary Gears, Principles Of Operation, Pt. 2, Multiple Sets, 16mm, Agency No. TF09-1856
Planning A Dovetail Slide, 16mm, Agency No. OE 067
Planning A Flat Surface, 16mm, Agency No. OE 66
Planning Rough Surfaces To Dimensions, 16mm Agency No. OE 301
Plunge Cut Grinding, 16mm, Agency No. OE 083
Preparing A Cupola For Charging, 16mm film, Agency No. OE 436
Rough Grinding With A Curvature Generator, 16mm film, Agency No. MN 02449D
Rough Grinding With Vertical Surface Grinder Flat Surfaces, 16mm, Agency No. MN 02449F

Rough-Facing, Turning, And Drilling, 16mm film, Agency No. OE 016
Safe Side Clyde, 16mm, Agency No. 7365
Safety Consciousness, 16mm, Agency Title No. 003534
Hobbing A Worm Gear - Infeed Method, 16mm film, Agency No. OE 234
Infeed Grinding A Shaft Of Two Diameters, 16mm film, Agency No. OE 088
Infeed Grinding Shouldered Work, 16mm film, Agency No. OE 087
Grinding A Deep Hole, 16mm film, Agency No. OE 078
Grinding A Parallel Bar, Pt. 1, Setting Up The Machine, 16mm film, Agency No. OE 220
Grinding A Parallel Bar, Pt. 2, Grinding Operations, 16mm film, Agency No. OE 221
Grinding A Plain Pin, Pt. 1, The Grinding Wheel, 16mm film, Agency No. OE 080
Grinding A Plain Pin, Pt. 2, Grinding Operations, 16mm film, Agency No. OE 081
Grinding A Slender Shaft With Back Rest, 16mm film, Agency No. OE 082
Grinding A Straight Hole, 16mm film, Agency No. OE 077
Grinding A Taper, 16mm, Agency No. OE 084
Grinding A Template, 16mm, Agency No. OE 222
Grinding A V Block, 16mm film, Agency No. OE 223
Grinding And Facing A Blind Hole, 16mm film, Agency No. OE 079
Grinding Thin Discs, 16mm, Agency No. OE 224
Making A Simple Core, 16mm, Agency No. OE 424
Molding A Horizontal Cored Part, 16mm film, Agency No. OE 431
Maintaining Good Working Conditions, 16mm, Agency No. OE 152
Setup For Face Milling With A Fixture, Agency No. OE 225
Setup For Rough Line Boring, Agency No. OE 228
Single Ram Vertical Surface Broaching, Agency No. OE 237
Sectional Views And Projections - Finish Marks, Agency No. OE 054
Sharpening A Form Relieved Cutter, Agency No. OE 093
Sharpening A Plain Helical Milling Cutter, Agency No. OE 091
Sharpening A Shell End Mill, Agency No. OE 092
Sharpening A Side Milling Cutter, Agency No. OE 090
Double Ram Vertical Surface Broaching, Agency No. OE 238
Drilling and Tapping Cast Steel, 16 mm film, Agency No. OE 022
Drilling To A Layout and Spotfacing Cast Iron, 16mm film, Agency No. OE 023
Drilling With Portable Drill Motors, 16mm film, Agency No. OE 138
Drilling, Tapping, Stubboring And Reaming, 16mm film, Agency No. OE 230
Designing A Pattern For A Water-Cooled Motor Block, 16mm film, Agency No. OE 337
Rough Line-Boring, 16mm film, Agency No. OE 229
Rough-Facing, Boring, And Turning A Shoulder, 16mm film, Agency No. OE 017
Rough Turning Between Centers, 16mm film, Agency No. OE 006
Reading A Drawing Of A Valve Bonnet, 16mm film, Agency No. OE 055
Reaming With Straight Hand Reamers, 16mm film, Agency No. OE 037
Reaming With Taper Hand Reamers, 16mm film, Agency No. OE 038
Rough Grinding With A Curvature Generator, 16mm film, Agency No. MN 02449D
Cutting And Threading Pipe On A Power Machine, Agency No. OE 107
Cutting With Carbide Tools, Pt. 1, Single Point, 16mm film, Agency No. OE 244
Cutting With Carbide Tools, Pt. 2, Milling Cutters, Agency No. OE 245

Contour Face Milling, 16mm film, Agency No. OE 227
Cutting A Dovetail Taper Slide, 16mm film, Agency No. OE 073
Cutting A Round End Keyway, 16mm film, Agency No. OE 074
Cutting A Short Rack, 16mm film, Agency No. OE 208
Cutting Keyways, 16mm film, Agency No. OE 012
Countersinking, Counter-Boring And Spot Facing, 16mm film, Agency No. OE 048
Chisels, 16mm film, Agency No. TF09-2028
Cutting Threads With Taps And Dies, 16mm film, Agency No. OE 034
Chuck Work, Pt. 2, Setting Up Tools For Combined Cuts, 16mm film, Agency No. OE 214
Cutting An External National Fine Thread, 16mm film, Agency No. OE 010
Cutting An Internal Taper Pipe Thread, 16mm film, Agency No. OE 057
Making A Simple Core, 16mm film, Agency No. OE 424
Molding A Horizontal Cored Part, 16mm film, Agency No. OE 431
Cutting An Internal ACME Thread, 16mm film, Agency No. OE 056
Cutting An External ACME Thread, 16mm film, Agency No. OE 045
Cutting And Threading Pipe By Hand, 16mm film, Agency No. OE 106
Care And Maintenance Of Tapered Roller Bearings, 16mm film, Agency No. TF11-0257
Machining Work Held In Chuck - Use Of Reference Surfaces, 16mm film, Agency No. OE 060
Machining A Cast Iron Rectangular Block, 16mm film, Agency No. OE 020
Machining A Tool Steel V Block, 16mm film, Agency No. OE 021
Measuring Pipe, Tubing And Fittings, 16mm film, Agency No. OE 105
Milling A Circular Slot, 16mm film, Agency No. OE 076
Milling A Helical Cutter, 16mm film, Agency No. OE 210
Milling A Helical Grove, 16mm film, Agency No. OE 075
Milling A Template, 16mm film, Agency No. OE 207
Making A Pattern For A Three Part Mold, 16mm film, Agency No. OE 326
Making Pattern, Core Boxes, And Assembling Cores For A Water-Cooled Motor Block, 16mm film, Agency No. OE 339
Measurement With Light Waves, 16mm film, Agency No. OE 174
Broaching An Internal Keyway, 16mm film, Agency No. OE 236
Behind The Shop Drawing, 16mm film, Agency No. MN0037
Bars, Punches And Drifts, 16mm film, Agency No. TF09-2030
Basic Layout Tools, Pt. 2, 16mm film, Agency No. MN07831B
Cutting Teeth On A Worm Gear, 16mm film, Agency No. OE 211
Trip Steel, Title No. 003803
True Standard, A, 16mm film, Title No. 762538
Hardness Testing - Rockwell, 16mm film, Agency No. OE 149
Maintaining Quality Standards, 16mm film, Agency No.OE 164
Molding With A Gated Pattern, 16mm film, Agency No. OE 427
Micrometer, The, 16mm film, Agency No. OE 002
Machining Laminated Plastics, 16mm film, Agency No. OE 475
Grinding Multiple-Point Carbide Tools, 16mm film, Agency No. OE 243
Grinding Single-Point Carbide Tools, 16mm film, Agency No. OE 242
Gauge Blocks And Accessories, 16mm film, Agency No. OE 246
Principles of Lubrication, 16mm film, Agency No. OE 355
Pliers And Screw Drivers, 16mm film, Agency No. TF9-2027
Powder Metallurgy, Pt. 1, Principles and Uses, 16mm film, Agency No. OE 346
Powder Metallurgy, Pt. 2, Manufacture Of Porous Bronze Bearings, 16mm film, Agency No. OE 347

Plain Indexing And Cutting A Spur Gear, 16mm film, Agency No. OE 015
Precision Gauge Blocks, 16mm film, Agency No. OE 49
Boring To Close Tolerances, 16mm film, Agency No. OE 059
Boring Holes With Offset Boring Head, 16mm film, Agency No. OE 209
Bevel Protractor, The, 16mm film, Agency No. OE 050
Sharpening An Angular Cutter, 16mm film, Agency No. OE 094
Setting Up And Machining Bar Stock, 16mm film, Agency No. OE 215
Sawing An Internal Irregular Shape, 16mm film, Agency No. OE 239
Sawing Template Metal, 16mm film, Agency No. OE 128
Sawing A Reverse Curve And A Bevel Reverse Curve, 16mm film, Agency No. OE 310
Sawing With Jig And Changing Band, 16mm film, Agency No. OE 309
Straddle And Surface Milling To Close Tolerances, 16mm film, Agency No. OE 013
Straddle Milling, 16mm film, Agency No. OE 014
Using A Boring Bar Between Centers-Work Held On Carriage, 16mm film, Agency No. OE 064
Using A Follower Rest, 16mm film, Agency No. OE 063
Using A Steady Rest, 16mm film, Agency No. OE 062
Using A Steady Rest When Boring, 16mm film, Agency No. OE 065
Using A Shell End Mill, 16mm film, Agency No. OE 072
Verniers, 16mm film, Agency No. OE 004
Wrenches, 16mm film, Agency No. TF09-2026
Threading Taps And Dies, Part VII, 16mm film, Agency No. MN 07831G
Turning A Taper With The Tailstock Set Over, 16mm film, Agency No. OE 044
Turning Work Held On A Fixture, 16mm film, Agency No. OE 058
Turning Work Held On A Mandrel, 16mm film, Agency No. OE 061
Turning Work In A Chuck, 16mm film, Agency No. OE 316
Turning Work Of Two Diameters, 16mm film, Agency No. OE 007
Turning Work On A Face Plate, 16mm film, Agency No. OE 315
Turret Lathe, The - An Introduction, 16mm film, Agency No. OE 212
Steel Rule, 16mm film, Agency No. OE 001
Scraping Flat Surfaces, 16mm film, Agency No. OE 035
Shaper, The, 16mm film, Agency No. OE 070
Face Milling With A Fixture, 16mm film, Agency No. OE 226
Filing, 16mm film, Agency No. OE 240
Filing An Internal Irregular Shape, 16mm film, Agency No. OE 240
Filing Template Metal, 16mm film, Agency No. OE 129
Fitting & Scraping Small Bearings, 16mm film, Agency No. OE 036.
Fixed Gauges, 16mm film, Agency No. OE 003
Drilling To A Layout And Spotfacing Cast Iron, 16mm film, Agency NO. OE 023
Elements Of Hardening, 16mm film
Elements Of Tempering, Normalizing And Annealing, 16mm film
Inspection Of Threads, 16mm film, Agency No. OE 148
Locating Holes, Drilling And Tapping In Cast Iron, 16mm film, Agency No. OE 047
Laying Out Small Castings, 16mm film, Agency No. OE 40
The Lathe, 16mm film, Agency No. OE 068
Bar Work - Magnesium, Pt. 1 Setting Up Bar Mechanism and Roller Turner, 16mm film, Agency No. OE 216
Bar Work - Magnesium Pt. 2 Setting Up Multiple Roller Turner and Turning A Taper, 16mm film, Agency No. OE 217.
Bar Work - Magnesium, Pt. 3, Necking and Threading By Use Of Attachment And By Die H, 16mm film, Agency No. OE 218

Other Available Resources

Among other known sources of instructional assistance for machinist instructors is the Sanford Project funded by the North Carolina Occupational Research Unit. This was a project conducted by Sanford Central High School to develop instructional materials for high school courses. Machine shop was one of the courses included in the project. Competencies, skills, task packages, and sound/slide programs were developed to support laboratory instruction and practice. For further information on the project contact either the Machine Shop Instructor, Lee County Senior High School, Sanford, NC or the Local Director of Occupational Education, Lee County Board of Education, Lee County Office Building, Sanford, NC 27330. Copies of the slides developed in this project are available through Camera Corner, 275 West Front Street, Burlington, NC, Attn: Ray Bailey. Master tapes for each program can be provided by the Department of Public Instruction for the cost of the tapes. Contact Johnny Shaver, Division of Educational Media, Department of Public Instruction, Education Building, Raleigh, NC 27611. Information on the Learning Activity Packages (LAPS) developed in the project is available by contacting Meg Murphy, Division of Vocational Education, Department of Public Instruction, Education Building, Raleigh, NC 27611.

Also of interest may be the Machine Shop Career Cluster Project coordinated by the South Carolina Occupational Research Unit. This project used the Sanford Project as a model to develop a self instructional program for both high school and post-secondary machine shop programs. This project has 244 learning activity packages, 190 audio visual units that provide a total of 4500 color slides (35mm) and 138 tests. For more information, contact William Wyrick, Curriculum Coordinator, Rutledge Building, 1429 Senate Street, State Department of Education, Columbia, SC 29201.

For information on machine shop films, audiovisuals, and instructional materials using a competency based approach contact Dr. William Knaak, Superintendent of Area School 916, Minnesota Industrial Materials Center, 3515 Jerry Street, White Bear Lake, MN 55110.

APPENDICES

MACHINIST COMPETENCY COMMITTEE

Robert Swan
Asheville-Buncombe Technical Institute
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Dean: Dr. Ed Bright

Jim Bass
Robeson Technical Institute
Drawer A
Lumberton, N C 28358
Dean: Fred Williams

Douglas Coone
Rockingham Community College
Wentworth, NC 27375
Dean: Dr. Bryan Brooks

Ken Hughes
Rt. 1, Box 306 A
High Point, NC 27260

Frank A. Gourley, Jr.
Department of Community Colleges
Education Building
Raleigh, NC 27611

MACHINIST CURRICULUM ADVISORY COMMITTEE

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Southeastern Machine & Tool Company
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Tom Erickson, Mech. Engineer
Forest City Tool Company
P.O. Box 788
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H. D. Willig, Plant Manager
Carter-Hickory Corporation
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Hickory, NC 28601

E. A. Mitchell, Maintenance Manager
General Electric Corporation
Fairgrove Church Road
Hickory, NC 28601

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Dennison Machine and Tool Company
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Hickory, NC 28601

Lester O. Fulcher
Superintendent of Maintenance
Karastan Rug Division
Fieldcrest Mills
Eden, NC 27288

Larry M. Currie
Projection Products
P.O. Box 909
Newton, NC 28658

W. D. King, Supt. Machine Shop
Long Manufacturing Company
Tarboro, NC 27886

Travis Wooten
Empire Brush Company
Greenville, NC 27834

David S. Miller, Supt. Machine Shop
Adams-Millis Corporation
400 English Road
High Point, NC 27260

W. L. Blalock
Piedmont-American Corporation
4032 Bessemer City Road
Gastonia, NC 28052

Wallace Burke
Division of Occupational Education
Depart. of Public Instruction
Education Building
Raleigh, NC 27611

Kenneth Thomas
Machine Shop Teacher
Sanford Central High School
1708 Nash Street
Sanford, NC 27330

Sam Blanton
Machine Shop Teacher
Millbrook High School
2201 Spring Forest Road
Raleigh, NC 27609

NOTE: All Machinist Competency Committee members were also members of this committee.

MACHINE SHOP INDUSTRIES SURVEYED

Beaufort County Technical Institute

Atwood Morrill Company
Washington, NC 27889
Attn: David Fussell
Plant Manager

Carver Machine Service
1054 East Main Street
Washington, NC 27889
Attn: Bill Carver

Empire Brush Company
Greenville, NC 27834
Attn: Travis Wooten

Hamilton Beach Company
Washington, NC 27889
Attn: Stan Figluski
Personnel Department

Long Manufacturing Company
Tarboro, NC
Attn: Mr. Bill King, Superint.
Machine Shop

Winterville Machine Works
Winterville, NC 28590
Attn: Mr. B. B. Barwick
General Manager

Caldwell Community College

Buss Automation
511 Creekway Drive, NW
Lenoir, NC 28645
Attn: Mr. Jack Buss

Eaton Corporation
Industrial Truck Division
North Philadelphia, PA
Attn: Mr. Nick D'Arca

Hickory Carter Carburetor
Pate Blvd.
Hickory, NC 28601
Attn: Joel McCrary

Caldwell Community College (con't)

Hickory Springs Manufacturing
2200 Main Avenue, S. E.
Hickory, NC 28601
Attn: Mr. Berry Spicer

Jacumin Engineering & Machine Inc.
Box A
Icard, NC 28666
Attn: Mr. Lloyd Whitner

Catawba Valley Technical Institute

Carter Hickory Corp.
Tate Blvd.
Hickory, NC 28601
Attn: Mr. Herbert Willick, Mgr.

Dennison Machine Company
417 11th St., NW
Hickory, NC 28601
Attn: Mr. C. F. Lutz, President

General Electric Co.
Fairgrove Church Road
Hickory, NC 28601
Attn: Ed Mitchell, Mgr. Maint.

Projection Products
P.O.Box 909
Newton, NC 28658
Attn: Larry M. Currie

J. C. Steel Company
Statesville, NC 28677
Attn: Mr. B. Kunkle
Personnel Manager

Central Piedmont Community College

Charlotte Machine Company
P.O. Box 3362
Charlotte, NC 28202
Attn: William Gribble, Pres.

Central Piedmont Community College con't

The Duff-Norton Company
100 Pioneer Road
Charlotte, NC 28210
Attn: Mr. Ray Crowson
Director of Personnel

Pneumafil Corporation
2516 Wilkinson Blvd.
Charlotte, NC 28208
Attn: Mr. Pete Fenninger, Engr. Mgr.

Ronson Hydraulic Units
530 Sugar Creek Rd.
Charlotte, NC 28213
Attn: Mr. John Dayvault, Mfg. Engr. Mgr.

Southeastern Tool & Die Co., Inc.
1420 Metals Drive
Charlotte, NC 28206
Attn: Mr. Neal Lackey
Assistant Plant Mgr.

The Terrell Machine Co.
P.O. Box 928
Charlotte, NC 28208
Attn: W. C. House, Jr.
Personnel Mgr.

Fayetteville Technical Institute

Allis-Chalmers
Rt. 5
Sanford, NC 27330
Attn: William Rivers
Personnel Mgr.

The Black & Decker Mfg. Co.
P.O. Box 64429
Fayetteville, NC 28306
Attn: H. T. Hollings
Personnel Mgr.

Lufkin Rule Company
P.O. Box 728
Apex, NC 27502
Attn: Stewart Adams
Personnel Mgr.

Servtex Corp.
Industrial Drive
Sanford, NC 27330
Attn: Wayne Warner
Personnel Mgr.

Fayetteville Technical Inst. con't.

Southeastern Machine & Tool Co., Inc.
P.O. Box 31087
Raleigh, NC 27612
Attn: Jerry F. Richmond

Square D Company
Route 2
Knightdale, NC 27545
Attn: Richard Shaenzer
Personnel Mgr.

Forsyth Technical Institute

Bassick-Sack Division of Stewart-Warner Corp.
2941 Indiana Avenue
Winston-Salem, NC
Attn: Charles Stewart

Fairchild Industries, Inc.
1501 Fairchild Drive
Winston-Salem, NC
Attn: George Hoback

Hayes-Albion Corp.
Briggs-Shaffner Division
P.O. Box 10579
Salem Station
Winston-Salem, NC 27108
Attn: James VonCannon

J. Paul Idol Co.
1644 W. Mountain Street
Kernersville, NC
Attn: Paul Idol

R. J. Reynolds Industries Inc.
401 N. Main Street
Winston-Salem, NC
Attn: Moyer Hunt
Machine Shop Supt.

Straford Tool and Die Co.
3841 Kimwell Drive
Winston-Salem, NC 27103
Attn: A.G. Bodenhiemer

Gaston College

Gibson Machine Company
Highway 321, North
Dallas, NC 28034
Attn: Mr. Grayson A. Kellar

Gaston College con't

Kluttz Machine & Foundry, Inc.
711 E. Franklin Avenue
Gastonia, NC 28052
Attn: Mr. Paul Farris, Jr.

Petty's Machine Company
Highway 321, South
Gastonia, NC 28052
Attn: Mr. Larry Petty

Piedmont American Corporation
4032 Bessemer City Road
Gastonia, NC 28052
Attn: Mr. Bill Blalock

SKF Textile Products, Inc.
1212 E. Industrial Avenue
Gastonia, NC 28052
Attn: Mr. Worth Gamble

Southeastern Tool & Die
Talon Division of Textron
Kings Mountain, NC 28086
Attn: Mr. Earl Riechel

Warner & Swasey Company
Gastonia Highway
Bessemer City, NC 28016
Attn: Geoffrey C. Mielenz

Guilford Technical Institute

Adams-Millis Corporation
400 English Road
High Point, NC 27260
Attn: David Miller
Supervisor Machine Shop

Amp. Inc.
1126 Church Street
Greensboro, NC 27401
Attn: Dave Hensty
Tool & Die Shop Foreperson

Gilbarco Inc.
7300 Friendly Road
Greensboro, NC 27420
Attn: Len Tourville
Supervisor Engineering

Modern Tools, Inc.
2012 Fairfax Road
Greensboro, NC 27407
Attn: Ron Wozny
Plant Manager

Guilford Technical Institute con't

Mold & Tool Craft Inc.
Rt. 6, Box 621-C
Thomasville, NC
Attn: Mr. Jim Lathan, Owner

Southern Die Casting Company
206 Albertson Road
High Point, NC 27260
Attn: Robert Lees

Lenoir Community College

Buehler Products
P.O. Box A
Highway 70 East
Kinston, NC 28501
Attn: Bill Hutchinson

Joy Manufacturing
Highway 70 East By-pass
LaGrange, NC 28551
Attn: Walter VanHorn

Stanley Power Tools
P.O.Box 2217
New Bern, NC 28560
Attn: Bill Pryor

Wall-Lenk Manufacturing Co.
Greenville Highway
Kinston, NC 28501
Attn: L.W. Sheley

West Company
Route 7, Box 120
Kinston, NC 28501
Attn: Terry Tyndall

Randolph Technical Institute

Allen Machine & Supply Co.
420 Industrial Park Avenue
Asheboro, NC 27203
Attn: Mr. Hayden Allen

Klopman Mills Engineering Department
Asheboro Plant
Asheboro, NC 27203
Attn: James Johnston

Klopman Mills
Ramseur Plant
Ramseur, NC 27316
Attn: Yates Spargo

Randolph Technical Institute con't

Union Carbide Corporation
800 Albemarle Road
Asheboro, NC 27203
Attn: Mr. Austin Shaw

Robeson Technical Institute

Acme Electric Corporation
Lumberton, NC 28358
Attn: Mr. Tom Long

Alamac Knitting Company
South Chestnut Street
Lumberton, NC 28358
Attn: Pete Geier

Converse Rubber Company
Lumberton, NC 28358
Attn: Plant Manager

Gunmar Machine Company
310 Hinest Street
Lumberton, NC 28358
Attn: Dennis Martin

Mueller Steam Speciality Company
901 Carolina Avenue
Lumberton, NC 28358
Attn: Plant Manager

National Twist Drill Company
Maxton, NC 28368
Attn: Robert Wright

Pembroke Machine Company
Pembroke, NC 28372
Attn: Mr. Lowry

Veder Root
Elizabethtown, NC 28337
Attn: Plant Manager

Rockingham Community College

A & S Tool and Die, Inc.
P.O. Box 487
Kernersville, NC 27284
Attn: Jack Hale, President

Rockingham Community College con't

Belews Creek Steam Station
Duke Power Company
P.O. Box 557
Walnut Cover, NC 27052
Attn: John Faysoux
Administrative Service
Supervisor

E. I. Dupont De Nemours
P.O. Box 4831
Martinsville, VA 24112
Attn: Richard L. Jenkins
Personnel Specialist

Fieldcrest Mills, Inc.
Stadium Drive
Eden, NC 27288
Attn: Betty Tate
Employment Manager

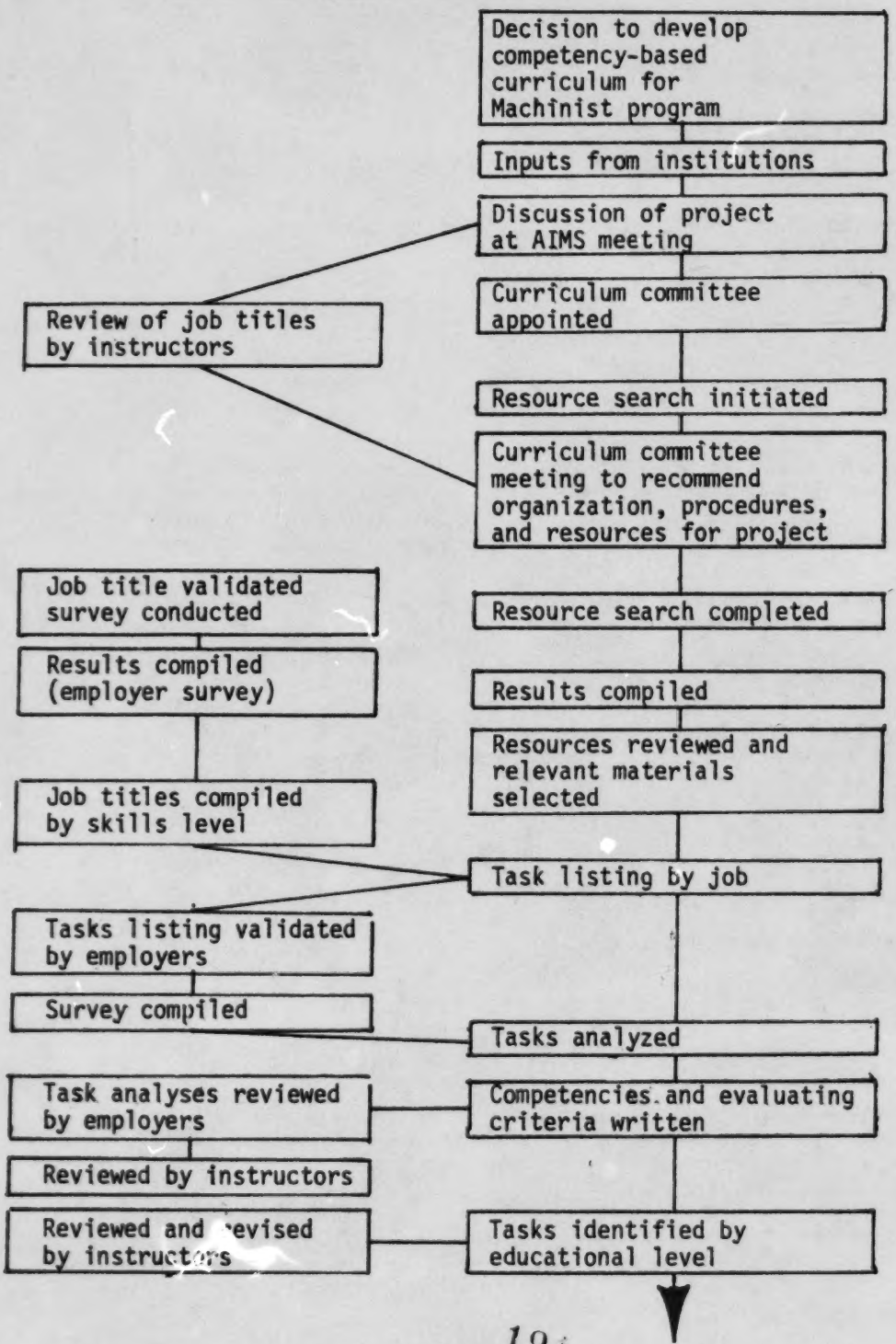
Industrial Engineering & Machine Co.
606 Walters Street
Reidsville, NC 27320
Attn: Floyd G. Hardin,
Vice President

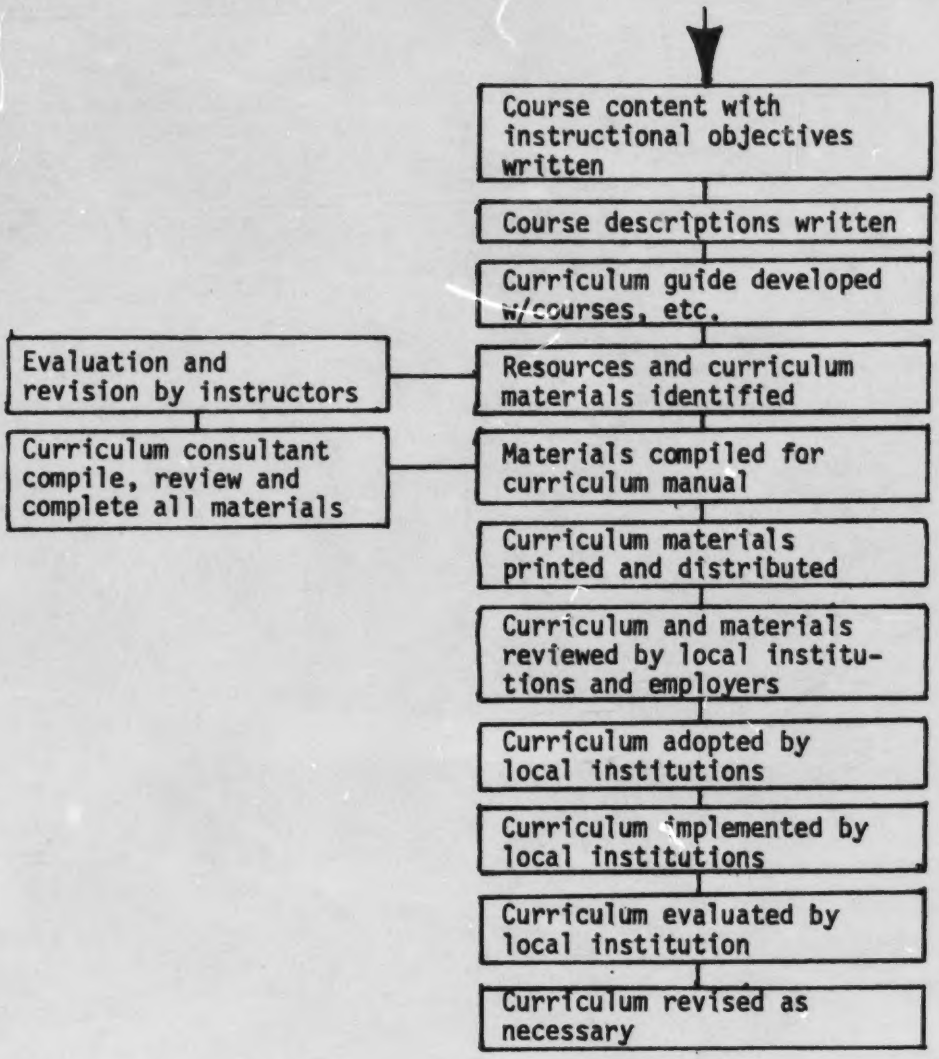
Reidsville Branch of American
Tobacco Co.
P.O. Box 930
Reidsville, NC 27320
Attn: J.G. Alston
Community Relations Coordinator

Wysong & Miles Company
P.O.Box 21168
Greensboro, NC 27420
Attn: Dick Aldridge
Vice President in charge
of Personnel

Zarn, Inc.
P.O. Box 1350
Reidsville, NC 27320
Attn: Linda Lewis,
Personnel Manager

ACTIVITY NETWORK
MACHINIST CURRICULUM


Decision to develop competency-based curriculum for Machinist program
Inputs from institutions
Discussion of project at AIMS meeting
Curriculum committee appointed
Review of job titles by instructors
Resource search initiated
Curriculum committee meeting to recommend organization, procedures, and resources for project
Job title validated survey conducted
Resource search completed
Results compiled (employer survey)
Results compiled
Resources reviewed and relevant materials selected
Job titles compiled by skills level
Task listing by job
Tasks listing validated by employers
Survey compiled
Tasks analyzed
Task analyses reviewed by employers
Competencies and evaluating criteria written
Reviewed by instructors
Reviewed and revised by instructors
Tasks identified by educational level


Course content with instructional objectives written
Course descriptions written
Curriculum guide developed w/courses, etc.
Resources and curriculum materials identified
Evaluation and revision by instructors
Materials compiled for curriculum manual
Curriculum consultant compile, review and complete all materials
Curriculum materials printed and distributed
Curriculum and materials reviewed by local institutions and employers
Curriculum adopted by local institutions
Curriculum implemented by local institutions
Curriculum evaluated by local institution
Curriculum revised as necessary

DEFINITION OF TERMS

For the purpose of clarifying the meanings of specific terms in this project the following words are defined:

Attitude - mental position, a feeling or an emotion toward a face or state; a predisposition to act in a certain way; a state of readiness that influences a person to act in a given manner.

Competency - sufficient judgement, skill and knowledge to perform a particular task.

Competency-Based Education- the educational process that specifies learning goals in measurable terms and requires that the learner achieve observable behavior changes in knowledge, skill and/or attitude to demonstrate competency before proceeding to more complex goals.

Competency-Based Instruction- the sequencing and modularization of curriculum into small, manageable units of instruction. The key concept is the student's ability to perform on each segment of the curriculum.

Curriculum - a course or group of courses organized in a logical sequence to meet occupational educational goals.

Curriculum Advisory Committee - a group of local representatives including employees, employers, secondary and post-secondary educators who counsel and advise the institutions regarding the improvement of occupational programs, in an effort to more adequately meet the needs of the community.

Educators - refer to individuals employed in educational institutions and in local, state or federal agencies, both secondary and post secondary.

Job Analysis - a detailed listing of tasks currently being performed by workers in a clearly defined, specific job.

Knowledge - the recall of specifics and universals, the recall of methods and processes and the recall of a pattern.

Learning Experience - an activity planned by educational institutions whereby the student can practice behavior implied by the objectives.

Occupational Survey - a procedure using mail questionnaires and/or personal interviews to gain knowledge of a community, educational interests or occupational needs to assist in planning.

Skill - the ability to use one's knowledge effectively and readily in execution or performance--dexterity or coordination in the execution of learned physical or mental tasks.

Syllabus - a course guide which includes overall and specific educational objectives; an arrangement of subject matter; learning experiences to give direction in meeting the stated objectives and texts and references. An illustration of evaluation techniques may be included.

Task - a logically related set of actions required for the completion of a job objective; also a task may be a complete job element.

Task Analysis - a study to determine the steps a worker must know and the key points of knowledge to know in order to perform a given task.

Technical Programs - consist of occupational-oriented courses and general education courses that lead to the awarding of an Associate in Applied Science Degree and prepare students for jobs in paraprofessional fields.

Understanding - the power to make experience intelligible by applying concepts and theories; the comprehension of ideas and the ability to use abstractions in particular and concrete situations.

Vocational Programs - systematic groups of courses or sequences of subjects designed to train students for skilled or semiskilled employment opportunities.

Appendix F
CAREER OPPORTUNITY
SURVEY AND RESPONSE

DEPARTMENT OF
COMMUNITY COLLEGES
NORTH CAROLINA STATE BOARD OF EDUCATION
RALEIGH 27611

November 29, 1976

MEMO TO: Selected Machine Shop Employers

FROM: Frank A. Gourley, Jr.

SUBJECT: Career Opportunity Survey

The Program Development Division, Department of Community Colleges, is conducting a project to determine the competencies required by employers in order for their employees to be successful on the job. This project is designed to: (1) develop a validated list of tasks performed by employees in a given job; (2) develop from the tasks, competencies which are required to perform successfully in the job; (3) develop curriculum guidelines; and (4) develop and/or revise curriculum materials based on the guidelines to assist educational personnel in providing quality occupational education programs. You, as a member of the employment field, can provide essential information for the development of competency-based programs.

You have been selected to assist in determining employment opportunities in machine shop occupations. The enclosed form identifies careers open to individuals in this field. These opportunities may or may not exist. Please add titles of other jobs you feel exist for persons interested in this field. Your response to the survey will contribute to the identification of jobs that do exist.

After you have completed the survey, please return it in the stamped, self-addressed envelope by December 17, 1976. Your responses will be compiled with the responses of other individuals completing the survey, with no individual responses identified.

Your participation in this project by the completion of this survey is greatly appreciated.

FAG/bc

CC:

CAREER OPPORTUNITY SURVEY

The following employment opportunities have been identified as being possible careers open to individuals in machine shop. These opportunities may or may not exist.

Please indicate your opinion as to whether these employment opportunities do exist by checking (✓) the yes or no block next to the career identified. Please add additional opportunities that were omitted from the careers listed.

Career Opportunity	Yes	No	Comments
Machine Shop Foreman			
Machinist			
Machinist Apprentice			
Machinist, Experimental			
Maintenance Machinist			
Machine Set-up Operator			
Machine Try-out Man			
Lay-out Man			
Multi-purpose Machine Operator Tape Control			
Production - Machine Operator			
Machine Tool Operator, _____			
Machine Tool Operator, _____			
Die-Maker Apprentice			
Tool-and-Die-Maker Apprentice			
Tool-Machine Set-up Operator			
Tool-Maker Apprentice			
Quality Control Set-up and Lay-out Man			
Quality Control Foreman			

Career Opportunity	Yes	No	Comments
Helper Machinist			
Machine and Tool Assembler			
Heat Treater			
Mold Maker			
Tool Crib Attendant			
Tool & Cutter Grinder			
Automotive Machinist			
Instrument Maker			
Turret Lathe Set-up Man			
Turret Lathe Operator			
Tool Maker			
Tool & Die Maker			
Die Maker			
Tool & Die Foreman			
Other Opportunities			

Respondents Name & Title

Company

0-10 ☐ 11-50 ☐ 51-100 ☐ 100 + ☐

Number Employees in Machine Shop and Related

MAJOR CAREER CATEGORIES FROM CAREER OPPORTUNITY SURVEY RESPONSE

MACHINE SHOP

Question: Do employment opportunities exist for these jobs in North Carolina:

	Responses	
	Yes	No
Machine Tool Operator	35	8
Production Machine Operator	30	5
Helper Machinist	15	15
Multipurpose Machine Operator - Tape Control	26	12
Turret Lathe Operator	30	4
Machine Set-Up Operator	26	8
Tool Machine Set-Up Operator	27	11
Turret Lathe Set-Up Man	24	8
Machine Try-Out Man	9	18
Layout Man	13	17
Maintenance Machinist	24	9
Quality Control Technician (Foreman)	21	10
Quality Control Set-Up and Lay-Out Man	15	17
Machinist	42	2
Machinist Apprentice	31	5
Tool Crib Attendant	26	9
Tool & Die Maker	32	6
Tool & Die Maker Apprentice	23	11
Tool Maker Apprentice	22	12
Die-Maker Apprentice	16	7
Tool Maker	28	7
Die Maker	20	9
Mold Maker	25	13
Others		
Heat Treater	21	13
Tool & Cutter Grinder	25	9
Tool & Die Foreman	25	9
Machine Shop Foreman	38	3

Total Response 45
Number of Machinist Employers Surveyed 91
Percent Return 50%

MACHINE TRADES TASKS:
RESPONSE FROM INDUSTRY

The attached Machine Trades Tasks List identifies those tasks that employers and machinist instructors feel are required for each of the jobs listed. The survey was sent to forty-five employers and twenty-seven technical institutes and community colleges offering a machinist curriculum. Twenty-three employers and nine instructors responded to the survey. Determination of the tasks required for each job was made on the basis of a percent response. If greater than 25% of the employers or 33% of the instructors added a task to a job it was included as a required task to be taught in preparing a person for that job. All items with an "x" indicate that both employers and instructors felt the task to be required for the particular job. Items marked ⊗ were recommended by employers, but not by instructors.

The job categories identified are representative of the jobs available to persons with varying degrees of machinist skills. The categories and titles were determined from a summary of responses obtained from the Career Opportunity Survey which was sent to ninety-one employers for validation.

MACHINE TRADES TASKS	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker	
1.00 Orientation and Safety						
1.10 Orientation						
1.11 Demonstrate knowledge of master power switch locations....	x	x	x	x	x	
1.12 Demonstrate building/room evacuation route.....	x	x	x	x	x	
1.20 Safety						
1.21 Demonstrate use of safety equipment.....	x	x	x	x	x	
1.22 Clean and use safety glasses.....						
1.23 Use and abide by safety rules and regulations.....	x	x	x	x	x	
1.30 First Aid						
1.31 Demonstrate simple first aid procedures.....	x	x	x	x	x	
1.32 Use advanced first aid procedures.....						
2.00 Bench Work						
2.10 Hand Tools						
2.11 Use basic hand tools.....		x	x	x	x	
2.12 Use specialized hand tools.....						
2.20 Measuring Tools						
2.21 Use semi-precision measuring tools.....	x	x	x	x	x	
2.22 Use precision measuring tools.....	x	x	x	x	x	
2.23 Use the metric measurement tools.....	x	x	x	x	x	
2.30 Layout Work						
2.31 Prepare work pieces for layout.....		x	x	x	x	
2.32 Select and use layout tools and equipment.....		x	x	x	x	
2.33 Layout work piece.....						
2.34 Check work piece.....	x	x	x	x	x	

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker		
2.40 Hand Cutting Tools							
2.41 Select and use threading tools		x	x	x	x		
2.42 Select and use hand reamers		x	x	x	x		
2.43 Select and use chipping and gouging tools			x	x	x		
2.44 Select and use files	x	x	x	x	x		
2.50 Hand Assembling and Fitting							
2.51 Assemble parts with screws and nuts			x	x	x		
2.52 Fit parts using shrink, force, and running methods			x	x	x		
2.53 Lap parts to fit				x	x		
2.60 Portable Power Tools							
2.61 Use hand drills			x	x	x		
2.62 Use hand grinder			x	x	x		
2.63 Use chipping hammer			x		x		
2.70 Supplemental Operations							
2.71 Hand polish	x		x	x	x		
2.72 Use hand broaching tools	x		x	x	x		
2.73 Assemble with rivets			x	x	x		
2.74 Hand stamp work pieces (numbering and lettering)	x	x	x	x	x		
2.75 Use an etcher	x	x	x	x	x		
2.76 Extract screws and taps	x		x	x	x		
2.80 Inspection							
2.81 Set up inspection equipment		x		x	x		
2.82 Use inspection tools and gages	x	x		x	x		
2.83 Use mechanical testing equipment	x			x	x		

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker	
3.00 Power Sawing						
3.10 Reciprocating and Continuous Band Cut-Off Saw						
3.11 Select and install correct blade		x	x	x	x	
3.12 Establish feed and speed		x	x	x	x	
3.13 Clamp work piece	x	x	x	x	x	
3.14 Make straight cuts	x	x	x	x	x	
3.15 Make angular cuts	x	x	x	x	x	
3.20 Contour Band Saw (Sawing, Friction Cut, Filing)						
3.21 Select correct blade	x	x	x	x	x	
3.22 Weld blade	x	x	x	x	x	
3.23 Install blade		x	x	x	x	
3.24 Select feed and speed	x	x	x	x	x	
3.25 Saw a layout	x	x	x	x	x	
3.26 Contour saw a part	x	x	x	x	x	
3.30 Abrasive Saw						
3.31 Select wheel		x	x	x	x	
3.32 Select speed and feed		x	x	x	x	
3.33 Clamp work piece		x	x	x	x	
3.34 Cut part to specifications		x	x	x	x	
4.00 Drilling Operations						
4.10 Hand Feed Drill						
4.11 Select correct drill and drill a hole	x	x	x	x	x	
4.12 Counter sink a hole	x	x	x	x	x	
4.13 Counter bore a hole	x	x	x	x	x	
4.14 Ream a hole	x	x	x	x	x	

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker		
4.10 Hand Feed Drill (cont.)							
4.15 Tap a hole	x	x	x	x	x		
4.16 Hone a hole	x	x	x	x	x		
4.17 Lap a hole	x	x	x	x	x		
4.20 Power Feed Drill							
4.21 Select correct drill and drill a hole	x	x	x	x	x		
4.22 Counter sink a hole	x	x	x	x	x		
4.23 Counter bore a hole	x	x	x	x	x		
4.24 Ream a hole	x	x	x	x	x		
4.25 Tap a hole	x	x	x	x	x		
4.26 Hone a hole	x	x	x	x	x		
4.27 Lap a hole	x			x	x		
5.00 Lathes							
5.10 Engine Lathe							
5.11 Set up work in independent chuck	x	x	x	x	x		
5.12 Set up work in universal chuck	x	x	x	x	x		
5.13 Set up work in combination chuck	x	x	x	x	x		
5.14 Set up work in collects	x	x	x	x	x		
5.15 Set up work in face plate	x	x	x	x	x		
5.16 Set up work in centers	x	x	x	x	x		
5.17 Select proper feeds and speeds		x	x	x	x		
5.18 Select and/or grind cutting tools		x	x	x	x		
5.19 Perform turning and facing operations	x	x	x	x	x		
5.110 Perform threading operations	x	x	x	x	x		
5.111 Perform taper operations	x	x	x	x	x		
5.112 Perform drilling and reaming operations	x	x	x	x	x		
5.113 Perform boring operations	x	x	x	x	x		

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker		COMMENTS
5.10 Engine Lathe (cont.)							
5.114 Perform grinding operations	x			x	x		
5.115 Perform chamfering operations	x	x	x	x	x		
5.116 Perform knurling operations	x	x	x	x	x		
5.117 Perform free hand operations	x		x	x	x		o Recommended by instructors, not by employers
5.20 Turret Lathes							
5.21 Set up rear turret tooling and stops		x		x			
5.22 Set up cross slide tooling and stops		x		x			
6.00 Milling and Similar Machining Operations							
6.10 Milling Machines							
6.11 Select and mount milling cutter		x	x	x	x		
6.12 Select and mount work holding device		x	x	x	x		
6.13 Mill a flat surface	x	x	x	x	x		
6.14 Mill keyways	x	x	x	x	x		
6.15 Drill, ream, and bore holes	x	x	x	x	x		
6.16 Mill gears	x			x	x		
6.17 Mill T-slots	x	x	x	x	x		
6.18 Mill dove-tails	x	x	x	x	x		
6.19 Perform straddle and gang milling operations	x	x		x	x		
6.110 Select speeds and feeds		x		x	x		
6.20 Special Milling Machines, specify							
7.00 Shaper-Planer Operations							
7.10 Shaper-Planer							
7.11 Select proper feeds and speeds and make adjustments		o	x	x	x		
7.12 Shape or plane an internal or external keyway	x	x	x	x	x		

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	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
7.10 Shaper-Planer (cont.)					
7.13 Shape or plane a contour to layout lines	x			x	x
7.14 Shape or plane a horizontal surface	x		x	x	x
7.15 Shape or plane a vertical surface			x	x	x
7.16 Shape an angular surface			x	x	x
7.17 Use a forming tool for shaping or planing	x			x	x
7.18 Shape or plane using index heads	x			x	x
7.20 Specialized Shapers					
8.00 Abrasive Machining					
8.10 Precision Surface Grinding					
8.11 Operate the machine controls					
8.12 Select correct wheel, install, and adjust all safety devices		x		x	x
8.13 Check wheel for imperfections	x	x		x	x
8.14 True and dress a wheel and grind a surface	x	x		x	x
8.15 Balance the wheel					
8.16 Grind a flat surface	x	x		x	x
8.17 Grind a vertical surface	x	x	x	x	x
8.18 Grind an angular surface	x	x		x	x
8.110 Grind a slotted part	x	x		x	x
8.111 Cut off a hardened part	x	x		x	x
8.112 Grind a radius	x	x		x	x
8.113 Grind a bevel using sine bar	x	x		x	x
8.114 Step grind	x	x		x	x

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
8.10 Precision Surface Grinding (cont.)					
8.115 Grind surfaces perpendicular using holding devices.....	x	x		x	x
8.116 Use correct magnet chuck and attachments for surface grinder.....	x	x		x	x
8.117 Use brake dresser and crush grinder.....	x	x		x	x
8.118 Use ultra precision grinding procedures.....					x
8.20 Centerless Grinding					
8.21 Select the correct wheels, install, and adjust all safety devices.....		x		x	
8.22 Dress, true and balance the wheels.....		x		x	
8.23 Select, set up, and correct work guide and adjust blade height.....		x		x	
8.24 Through grind parts.....	x	x		x	
8.25 In-feed grind parts.....	x	x			
8.26 End feed grind parts.....					
8.27 Crush form grind parts.....	x	x		x	
8.28 Use wet or dry grinding methods.....	x				
8.30 Cylindrical Grinding					
8.31 Select the correct wheel and speeds of wheel and table...		x		x	x
8.32 Install the wheel and adjust all safety devices.....		x		x	x
8.33 Dress, true, and balance the wheel.....		x		x	x
8.34 Adjust longitudinal taper on table.....	x	x		x	x
8.35 Traverse grind a straight diameter.....	x	x		x	x
8.36 Plunge grind a work piece.....	x	x		x	x
8.37 Grind to a shoulder.....	x	x		x	x
8.38 Traverse grind an external taper.....	x	x		x	x
8.39 Grind between centers.....	x	x		x	x
8.310 Grind long part with workrests.....	x	x		x	x

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
8.30 Cylindrical Grinding (cont.)					
8.311 Grind a form (dressed on the wheel)	x	x		x	x
8.312 Set and grind a part on workhead attachments	x	x		x	x
8.313 Grind a part using an internal attachment					
8.40 Internal Grinding					
8.41 Select the correct wheel, install, and adjust all safety devices		x		x	x
8.42 Dress and true a wheel	x	x		x	x
8.43 Grind internal diameter, straight through	x	x		x	x
8.44 Plunge grind and face a shoulder	x	x		x	x
8.45 Grind an internal taper	x	x		x	x
8.50 Tool and Cutter Grinding					
8.51 Select the correct wheel, speeds, feed, and angles				x	x
8.52 Dress, true, and balance a wheel				x	x
8.53 Select and set up proper workrest to grind parts with proper primary and secondary clearance				x	x
8.54 Grind horizontal mill cutter				x	x
8.55 Grind cylindrical part between centers				x	x
8.56 Taper grind a cutter				x	x
8.57 Grind a form tool				x	x
8.58 Grind a step drill				x	x
8.59 Sharpen a reamer using the peripheral method				x	x
8.510 Grind ends and sides of an endmill with cup wheel				x	x
8.511 Grind a stagger tooth cutter					x
8.60 Bench and Pedestal Grinding					
8.61 Select the correct wheel and install		x	x	x	x
8.62 Dress and true the wheel		x	x	x	x

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
8.60 Bench and Pedestal Grinding (cont.)					
8.63 Set workrest and spark arrestor properly	●	x	x	x	x
8.64 Sharpen twist drills by freehand method		x	x	x	x
8.65 Sharpen a tool bit (freehand)	x	x	x	x	x
8.66 Deburr parts				x	x
8.67 Sharpen chisels, punches, and screwdrivers	x	x	x	x	x
8.68 Use wire brush	x	x	x	x	x
8.70 Buffing and Polishing					
8.71 Buff a flat surface	x	x		x	x
8.72 Buff a cylindrical surface	x	x		x	x
8.73 Buff to a shoulder	x	x		x	x
8.74 Buff a contoured surface	x	x		x	x
8.75 Select proper compounds for finishes	x	x		x	x
8.80 Lapping and Honing (Hand and Machine)					
8.81 Select proper lapping compounds and tools				x	x
8.82 Properly charge plate	x			x	x
8.83 Lap a cylindrical plug	x			x	x
8.84 Lap a hole	x			x	x
8.85 Lap a flat surface					
8.90 Honing					
8.91 Select proper honing speeds and settings		●		●	x
8.92 Select proper honing stones		●		●	x
8.92 Hone holes straight and true	●	●		●	x
9.00 Specialized Machining Processes					

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
9.10 Profiler or Pantograph					
9.11 Use a profiler					x
9.12 Use a pantograph					x
9.20 Numerical Controlled Machine					
9.21 Operate a numerical controlled machine	●	●		o	x
9.22 Set up a numerical controlled machine		●		o	x
9.30 Electrical Discharge Machine					
9.31 Operate an electrical discharge machine				o	●
9.32 Set up an electrical discharge machine				o	●
9.40 Jig Borer					
9.41 Set up and operate the jig borer and grinder				x	x
10.00 Applied Metallurgy					
10.10 Identification of Materials					
10.11 Identify ferrous metals	x	x	x	x	x
10.12 Identify non-ferrous metals	x	x	x	x	x
10.20 Heat Treatment					
10.21 Harden Metal				x	x
10.22 Anneal metal				x	x
10.23 Temper metal				x	x
10.24 Normalize metal				x	x
10.25 Harden tool steels					x
10.30 Testing					
10.31 Test hardness	x				x

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker	
10.30 Testing (cont.)						
10.32 Test tensile strength					x	
10.33 Test shear					x x	
10.34 Test for cracks					x	
11.00 Blueprint Reading and Sketching						
11.10 Blueprint Reading						
11.11 Visualize the shape of object	x	x	x	x	x	
11.12 Determine dimensions	x	x	x	x	x	
11.13 Interpret specifications	x	x	x	x	x	
11.20 Sketching						
11.21 Make sketches	x	x	[illegible]	x	x	
11.22 Make working drawings					x	
12.00 Math						
12.10 Arithmetic						
12.11 Perform basic operations	x	x	x	x	x	
12.12 Perform advanced operations						
12.20 Algebra						
12.21 Perform basic operations	x	x	x	x	x	
12.22 Perform advanced operations						
12.30 Geometry						
12.31 Perform basic operations		x		x	x	
12.32 Perform advanced operations						

	Machine Tool Operator	Machine Set-Up perator	Maintenance Machinist	Machinist	Tool & Die Maker
12.40 Trigonometry					
12.41 Perform basic operations		x		x	x
12.42 Perform advanced operations					x
12.50 Machinery Handbook					
12.51 Use the Machinery's Handbook		x	x	x	x
13.00 Welding					
13.10 Oxyacetylene					
13.11 Assemble and set up torch			x	x	x
13.12 Perform soldering operations			x	x	x
13.13 Perform brazing operations			x	x	x
13.14 Perform welding operations			x	x	x
13.15 Perform cutting operations			x	x	x
13.20 Arc					
13.21 Set up equipment			x	x	x
13.22 Select electrode			x	x	x
13.23 Perform welding operations			x	x	x
14.00 Other (please specify)					
15.00 Communications,					
15.10 Listening					
15.11 Listen to get meaning	x	x	x	x	x
15.12 Listen to get information	x	x	x	x	x

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
15.10 Listening (cont.)					
15.13 Listen to get facts in reports	x	x	x	x	x
15.14 Listen to understand a person	x	x	x	x	x
15.15 Listen to share feelings	x	x	x	x	x
15.20 Talking					
15.21 Talk to instruct		x		x	x
15.22 Talk to report on work progress, events, meetings		x	x	x	x
15.23 Talk to describe tasks to be performed, equipment to use		x	x	x	x
15.24 Talk to solve problems, convince of feasibility, technical reports		x	x	x	x
15.25 Talk to get ideas across, persuade, change behavior		x			x
15.30 Graphic Interpretations					
15.31 Interpret freehand sketches to get meaning	x	x	x	x	x
15.32 Interpret working/engineering drawings to get information	x	x	x	x	x
15.33 Interpret charts to aid understanding of data		x		x	x
15.34 Interpret diagrams to get understanding		x	x	x	x
15.35 Interpret graphs to study variations in data					x
15.36 Interpret maps					x
15.37 Interpret pictures					
15.40 Graphic Presentations					
15.41 Develop freehand sketches to clarify verbal explanations		x	x	x	x
15.42 Prepare drawings to express ideas				x	x
15.43 Prepare charts to organize ideas					
15.44 Develop diagrams to explain or describe action or movement					
15.45 Prepare graphs to explain variations in data					
15.46 Draw maps					
15.47 Select or draw pictures					

	Machine Tool Operator	Machine Set-Up Operator	Maintenance Machinist	Machinist	Tool & Die Maker
15.50 Reading					
15.51 Read instructions and work orders	x	x	x	x	x
15.52 Read technical journals				x	x
15.53 Read technical reports				x	x
15.54 Read memos	x	x	x	x	x
15.60 Writing					
15.61 Write work orders, procedural directions					
15.62 Write maintenance reports, progress reports			x		
15.63 Write technical reports					
15.64 Write memos					

TASKS BY JOB LEVEL

Common Tasks To All Machine Trades Surveyed

Task Code	
1.11	Demonstrate knowledge of master power switch locations
1.12	Demonstrate building/room evacuation route
1.21	Demonstrate use of safety equipment
1.22	Clean and use safety glasses
1.23	Use and abide by safety rules and regulations
1.31	Demonstrate simple first aid procedures
2.11	Use basic hand tools
2.21	Use semi-precision measuring tools
2.22	Use precision measuring tools
2.23	Use metric measurement tools
2.33	Layout work piece
2.34	Check work piece
2.41	Select and use threading tools
2.44	Select and use files
2.74	Hand stamp work pieces (numbering and lettering)
2.75	Use an etcher
3.13	Clamp workpiece for band saw cuts
3.14	Make straight cuts
3.15	Make angular cuts
3.21	Select, correct contour band saw blade
3.22	Weld band saw blade
3.24	Select feed and speed for contour band saw
3.25	Saw a layout using contour band saw
3.26	Contour saw a part
4.11	Select correct hand feed drill and drill a hole
4.12	Counter sink a hole using hand feed drill
4.13	Counter bore a hole using hand feed drill
4.14	Ream a hole using hand feed drill
4.15	Tap a hole using hand feed drill
4.16	Hone a hole using hand feed drill
4.21	Select correct power feed drill and drill a hole
4.22	Counter sink a hole using power feed drill
4.23	Counter bore a hole using power feed drill
4.24	Ream a hole using power feed drill
4.25	Tap a hole using power feed drill
4.26	Hone a hole using power feed drill
5.11	Set up lathe work in independent chuck
5.12	Set up work in universal chuck
5.13	Set up work in combination chuck
5.14	Set up work in collects
5.15	Set up work in face plate
5.16	Set up work in centers
5.19	Perform turning and facing operations on lathe
5.110	Perform threading operations
5.111	Perform taper operations
5.112	Perform drilling and reaming operations

5.113 Perform boring operations
5.115 Perform chamfering operations
5.116 Perform knurling operations
6.13 Mill a flat surface
6.14 Mill keyways
6.15 Drill, ream and bore holes using milling machine
6.17 Mill T-slots
6.18 Mill dove-tails
7.12 Shape or plane an internal or external keyway
8.11 Operate surface grinder controls
8.17 Grind a vertical surface
8.63 Set workrest and spark arrestor properly
8.65 Sharpen a tool bit (freehand)
8.67 Sharpen chisels, punches and screwdrivers
8.68 Use wire brush
10.11 Identify ferrous metals
10.12 Identify non-ferrous metals
11.11 Visualize the shape of object
11.12 Determine dimensions
11.13 Interpret specifications
11.21 Make sketches
12.11 Perform basic arithmetic operations
15.11 Listen to get meaning
15.12 Listen to get information
15.13 Listen to get facts in reports
15.14 Listen to understand a person
15.15 Listen to share feelings
15.31 Interpret freehand sketches to get meaning
15.32 Interpret working/engineering drawings to get information
15.51 Read instructions and work others
15.54 Read memos

Tasks Required Of Machine Tool Operator
(In Addition To Common Tasks)

2.71 Hand polish
2.72 Use hand broaching tools
2.76 Extract screws and taps
2.82 Use inspection tools and guage
4.17 Lap a hole using hand feed drill
4.27 Lap a hole using power feed drill
5.114 Perform grinding operations
5.117 Perform free ahdn operations
6.16 Mill gears
6.19 Perform straddle and gang milling operations
7.13 Shape or plane a contour to layout lines
7.14 Shape or plane a horizontal surface
7.17 Using a forming tool for shaping or planning
8.12 Select correct grinding wheel, install wheel, and adjust all safety devices
8.13 Check wheel for imperfections
8.14 True and dress a wheel and grind a surface
8.15 Balance the wheel
8.16 Grind a flat surface
8.17 Grind a vertical surface
8.18 Grind a slotted part
8.110 Cut off a hardened part using a surface grinder
8.111 Grind a radius
8.112 Grind a bevel using Sine Bar
8.113 Step grind
8.114 Grind surfaces perpendicular using holding devices
8.115 Use correct magnet chuck and attachments for surface grinder
8.116 Use brake dresser and crush grinder
8.24 Through grind parts on centerless grinder
8.25 In-feed grind parts on centerless grinder
8.26 End feed grind parts on centerless grinder
8.27 Crush form grind parts on centerless grinder
8.28 Use wet or dry grinding methods on centerless grinder
8.34 Adjust longitudinal taper on table of cylindrical grinder
8.35 Traverse grind a straight diameter
8.36 Plunge grind a workpiece
8.37 Grind to a shoulder
8.38 Traverse grind an external taper
8.39 Grind between centers
8.310 Grind long part with workrests
8.311 Grind a form (dressed on the wheel)
8.312 Set and grind a part on workhead attachments
8.42 Dress and true a wheel of internal grinder
8.43 Grind internal diameter, straight through
8.44 Plunge grind and face a shoulder
8.45 Grind an internal taper
8.71 Buff a flat surface
8.72 Buff a cylindrical surface
8.73 Buff to a shoulder
8.74 Buff a contoured surface

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8.75 Select proper compounds for finishes
8.81 Select proper compounds and tools for lapping
8.82 Properly charge plate
8.83 Lap a cylindrical plug
8.84 Lap a hole
8.85 Lap a flat surface
8.92 Hone holes straight and true
9.21 Operate on numerical controlled machine
10.31 Test metal for hardness

Tasks Required Of Machine Set Up Operator
(In Addition To Machine Tool Operator Tasks & Common Tasks)

2.31 Prepare work pieces for layout
2.32 Select and use layout tools and equipment
2.42 Select and use hand reamers
2.61 Use hand drills
2.62 Use hand grinder
2.81 Set up inspection equipment
3.11 Select and install correct band saw blade
3.12 Establish feed and speed for band saw
3.23 Install blade in contour band saw
3.31 Select abrasive saw wheel
3.32 Select abrasive saw speed and feed
3.33 Clamp workpiece for abrasive saw cuts
3.34 Cut part to specifications using abrasive saw
5.17 Select proper lathe feeds and speeds
5.18 Select and/or grind cutting tools
5.21 Set up rear turret tooling and stops
5.22 Set up cross slide tooling and stops
6.11 Select and mount milling cutter
6.12 Select and mount work holding device for milling machine
6.110 Select speeds and feeds for milling machine operations
7.11 Select proper feeds and speeds and make adjustments on shaper-planer
7.16 Shape and angular surface
8.21 Select the correct wheel, install and adjust all safety devices for centerless grinder
8.22 Dress, true and balance the wheels on centerless grinder
8.23 Select, setup and correct work guide and adjust blade height on centerless grinder
8.31 Select the correct wheel and speeds of wheel and table for cylindrical grinding
8.32 Install the wheel and adjust all safety devices on cylindrical grinder
8.33 Dress, true and balance the wheel of cylindrical grinder
8.41 Select the correct wheel, install and adjust all safety devices for internal grinder
8.61 Select the correct wheel, install and adjust all safety devices for bench and pedestal grinding
8.62 Dress and true the wheel for bench and pedestal grinding
8.64 Sharpen twist drills by freehand method
8.91 Select proper speeds and settings for honing
8.92 Select proper stones for honing
9.22 Set up a numerical controlled machine
12.21 Perform basic algebra operations
12.31 Perform basic geometry operations
12.41 Perform basic trigonometry operations
12.51 Use the Machinery Handbook
15.21 Talk to instruct
15.22 Talk to report on work progress, events, meetings
15.23 Talk to describe tasks to be performed, equipment to use
15.24 Talk to solve problems convince of feasibility, technical reports
15.25 Talk to get ideas across, persuade, change behavior

15.33 Interpret charts to aid understanding of data
15.34 Interpret diagrams to get understanding
15.41 Develop freehand sketches to clarify verbal explanations

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Tasks Required Of The Machinist
(In Addition To Common Tasks Machine Tool Operator Tasks,
And Machine Set Up Operator Tasks)

2.43 Select and use chipping and gouging tools
2.51 Assemble parts with screws and nuts
2.52 Fit parts using shrink, force and running methods
2.53 Lap parts to fit
2.73 Assemble with rivets
8.51 Select the correct wheel, speeds, feed and angles for tool and cutter grinding
8.52 Dress, true and balance the wheel for tool and cutter grinding
8.53 Select and setup proper workrest to grind part with proper primary and secondary clearance
8.54 Grind horizontal mill cutter
8.55 Grind cylindrical part between centers
8.56 Taper grind a cutter
8.57 Grind a form tool
8.58 Grind a step drill
8.59 Sharpen a reamer using the peripheral method
8.50 Grind ends and sides of an endmill with cup wheel
9.31 Operate an electrical discharge machine
9.32 Set up an electrical discharge machine
9.41 Set up and operate the jig borer and grinder
10.21 Harden metal
10.22 Anneal metal
10.23 Temper metal
10.24 Normalize metal
10.25 Harden tool steels
13.11 Assemble and set up oxyacetylene torch
13.12 Perform soldering operations
13.13 Perform brazing operations
13.14 Perform welding operations
13.15 Perform cutting operations
13.21 Set up arc welding equipment
13.22 Select electrode for arc welding
13.23 Perform arc welding operations
15.42 Prepare drawings to express ideas
15.52 Read technical journals
15.53 Read technical reports

Tasks Required Of Maintenance Machinist I
(In Addition To Common Tasks)

2.31 Prepare work pieces for layout
2.32 Select and use layout tools and equipment
2.42 Select and use hand reamers
2.43 Select and use chipping and gouging tools
2.51 Assemble parts with screws and nuts
2.52 Fit parts using shrink, force and running methods
2.61 Use hand drills
2.62 Use hand grinder
2.63 Use chipping hammer
2.71 Hand polish
2.72 Use hand boraching tools
2.73 Assemble with rivets
2.76 Extract screws and taps
3.11 Select and install correct band saw blade
3.12 Establish feed and speed for band saw
3.23 Install blade in contour band saw
3.31 Select abrasive saw wheel
3.32 Select abrasive saw speed and feed
3.33 Clamp workpiece for abrasive saw cuts
3.34 Cut part to specifications using abrasive saw
5.17 Select proper lathe feeds and speeds
5.18 Select and/or grind cutting tools
5.17 Perform freehand operations
6.11 Select and mount milling cutter
6.12 Select and mount work holding device for milling machine
7.11 Select proper feeds and speeds and make adjustments on shaper-planer
7.14 Shape or plane a horizontal surface
7.15 Shape or plane a vertical surface
7.16 Shape an angular surface
8.61 Select the correct wheel, install, and adjust all safety devices for bench and pedestal grinding
8.62 Dress and true the wheel for bench and pedestal grinding
8.64 Sharpen twist drills by freehand method
12.51 Use the Machinery's Handbook
13.11 Assemble and set up oxyacetylene torch
13.12 Perform soldering operations
13.13 Perform brazing operations
13.14 Perform welding operations
13.15 Perform cutting operations
13.21 Set up arc welding equipment
13.22 Select electrode for arc welding
13.23 Perform arc welding operations
15.22 Talk to report on work progress, events, meetings
15.23 Talk to describe tasks to be performed, equipment to use
15.24 Talk to solve problems, convince of feasibility, technical reports
15.34 Interpret diagrams to get understanding
15.41 Develop freehand sketches to clarify verbal explanations
15.62 Write maintenance reports, progress reports

Tasks Required Of The Tool & Die Maker
(In Addition To Those Required For The Machinist)

8.117 Use ultra precision grinding procedures
8.511 Grind a stagger tooth cutter
9.11 Use a profiler
9.12 Use a pantograph
10.25 Hardentool and high speed steels
10.32 Test a metal for tensile strength
10.33 Test metal for shear
10.34 Test for cracks
11.22 Make working drawings
12.42 Perform advanced trigonometry operations
15.35 Interpret graphs to study variations in data
15.36 Interpret maps

SUGGESTED MACHINE TRADES TASKS

BY QUARTERS

This task list has been used as the working base for identifying curriculum content by course for the machinist curriculum.

The suggested machine trades tasks by quarters have been derived from the machine trades task response from industry and from review and evaluation by machinist instructors. Tasks are arranged by quarter to help students develop a background of skills that will enable their entry to progressive levels of employment as they proceeded through the curriculum.

All items with an "x" indicate the quarter in which initial instruction is recommended to be provided on the topic. Some tasks require additional practice and/or advanced instruction to develop sufficient skill to perform at a level expected of the machinist. These tasks are keyed for additional practice, "o", and advanced instruction, "*". A few tasks are included that may be developed through additional education. These tasks are marked in the column "Additional Education."

SUGGESTED MACHINE TRADES TASKS BY QUARTERS	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
1.00 Orientation and Safety							
1.10 Orientation							
1.11 Demonstrate knowledge of master power switch locations....	x						x Instruction
1.12 Demonstrate building/room evacuation route.....	x						
1.20 Safety							o Additional Practice
1.21 Demonstrate use of safety equipment.....	x	o	o	o			
1.22 Clean and use safety glasses.....	x						* Advanced Instruction
1.23 Use and abide by safety rules and regulations.....	x	o	o	o			
1.30 First Aid							
1.31 Demonstrate simple first aid procedures.....	x						
1.32 Use advanced first aid procedures.....	x						
2.00 Bench Work							
2.10 Hand Tools							
2.11 Use basic hand tools.....	x	o	o	o			
2.12 Use specialized hand tools.....	x	o	o	o			
2.20 Measuring Tools							
2.21 Use semi-precision measuring tools.....	x	o	o	o			
2.22 Use precision measuring tools.....	x	*	*	o			
2.23 Use the metric measurement tools.....	x	*	o	o			
2.30 Layout Work							
2.31 Prepare work pieces for layout.....	x	o	o	o			
2.32 Select and use layout tools and equipment.....	x	o	o	o			
2.33 Layout work piece.....	x	o	o	o			
2.34 Check work piece.....	x	o	o	o			

	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
2.40 Hand Cutting Tools							
2.41 Select and use threading tools	x	o	o	o			x Instruction
2.42 Select and use hand reamers	x	o	o	o			
2.43 Select and use chipping and gouging tools	x	o	o	o			o Additional Practice
2.44 Select and use files	x	o	o	o			
2.50 Hand Assembling and Fitting							* Advanced Instruction
2.51 Assemble parts with screws and nuts		x	o	o			
2.52 Fit parts using shrink, force, and running methods		x	o	o			
2.53 Lap parts to fit				x			
2.60 Portable Power Tools							
2.61 Use hand drills	x	o	o	o			
2.62 Use hand grinder				x			
2.63 Use chipping hammer					x		
2.70 Supplemental Operations							
2.71 Hand polish	x	o	o	o			
2.72 Use hand broaching tools		x					
2.73 Assemble with rivets				x			
2.74 Hand stamp work pieces (numbering and lettering)	x	o	o	o			
2.75 Use an etcher	x	o	o	o			
2.76 Extract screws and taps		x	o	o			
2.80 Inspection							
2.81 Set up inspection equipment	x	*	o	o			
2.82 Use inspection tools and gages	x	*	o	o			
2.83 Use mechanical testing equipment							

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
3.00 Power Sawing							
3.10 Reciprocating and Continuous Band Cut-Off Saw							
3.11 Select and install correct blade		x	o	o			x Instruction
3.12 Establish feed and speed	x	*	o	o			
3.13 Clamp work piece	x	o	o	o			o Additional Practice
3.14 Make straight cuts	x	o	o	o			
3.15 Make angular cuts	x	o	o	o			* Advanced Instruction
3.20 Contour Band Saw (Sawing, Friction Cut, Filing)							
3.21 Select correct blade		x	o	o			
3.22 Weld blade		x	o	o			
3.23 Install blade		x	o	o			
3.24 Select feed and speed	x	*	o	o			
3.25 Saw a layout	x	o	o	o			
3.26 Contour saw a part	x	*	o	o			
3.30 Abrasive Saw							
3.31 Select wheel			x	o			
3.32 Select speed and feed			x	o			
3.33 Clamp work piece			x	o			
3.34 Cut part to specifications			x	o			
4.00 Drilling Operations							
4.10 Hand Feed Drill							
4.11 Select correct drill and drill a hole	x	*	o	o			
4.12 Counter sink a hole	x	*	o	o			
4.13 Counter bore a hole	x	*	o	o			
4.14 Ream a hole	x	*	o	o			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
4.10 Hand Feed Drill (cont.)							
4.15 Tap a hole	x	*	o	o			x Instruction
4.16 Hone a hole				x			
4.17 Lap a hole				x			o Additional Practice
4.20 Power Feed Drill							
4.21 Select correct drill and drill a hole			x				
4.22 Counter sink a hole			x				* Advanced Instruction
4.23 Counter bore a hole			x				
4.24 Ream a hole			x				
4.25 Tap a hole			x				
4.26 Hone a hole			x				
4.27 Lap a hole			x				
5.00 Lathes							
5.10 Engine Lathe							
5.11 Set up work in independent chuck		x	*	o			
5.12 Set up work in universal chuck	x	o	o	o			
5.13 Set up work in combination chuck				x			
5.14 Set up work in collects	x	o	o	o			
5.15 Set up work in face plate				x			
5.16 Set up work in centers	x	o	o	o			
5.17 Select proper feeds and speeds	x	*	o	o			
5.18 Select and/or grind cutting tools	x	*	o	o			
5.19 Perform turning and facing operations	x	*	o	o			
5.110 Perform threading operations	x	o	o	o			
5.111 Perform taper operations		x	o	o			
5.112 Perform drilling and reaming operations	x	*	o	o			
5.113 Perform boring operations		x	o	o			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
5.10 Engine Lathe (cont.)							
5.114 Perform grinding operations				x			x Instruction
5.115 Perform chamfering operations	x	o	o	o			
5.116 Perform knurling operations	x	o	o	o			o Additional Practice
5.117 Perform free hand operations		x	o	o			
5.20 Turret Lathes							* Advanced Instruction
5.21 Set up rear turret tooling and stops				x	x		
5.22 Set up cross slide tooling and stops				x	x		
6.00 Milling and Similar Machining Operations							
6.10 Milling Machines							
6.11 Select and mount milling cutter		x	*	*			
6.12 Select and mount work holding device			x	*			
6.13 Mill a flat surface		x	*	*			
6.14 Mill keyways		x	*	*			
6.15 Drill, ream, and bore holes		x	*	*			
6.16 Mill gears				x			
6.17 Mill T-slots				x			
6.18 Mill dove-tails				x			
6.19 Perform straddle and gang milling operations		x	o	o			
6.110 Select speeds and feeds		x	*	o			
6.20 Special Milling Machines, specify							
7.00 Shaper-Planer Operations							
7.10 Shaper-Planer							
7.11 Select proper feeds and speeds and make adjustments			x				
7.12 Shape or plane an internal or external keyway					x		

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
7.10 Shaper-Planer (cont.)							
7.13 Shape or plane a contour to layout lines.....					x		x Instruction
7.14 Shape or plane a horizontal surface.....			x				
7.15 Shape or plane a vertical surface			x				o Additional Practice
7.16 Shape an angular surface.....			x				
7.17 Use a forming tool for shaping or planing.....			x				* Advanced Instruction
7.18 Shape or plane using index heads.....			x				
7.20 Specialized Shapers							
8.00 Abrasive Machining							
8.10 Precision Surface Grinding							
8.11 Operate the machine controls		x					
8.12 Select correct wheel, install, and adjust all safety devices.....		x		o			
8.13 Check wheel for imperfections.....		x	o	o			
8.14 True and dress a wheel and grind a surface.....		x					
8.15 Balance the wheel.....		x					
8.16 Grind a flat surface.....		x	o	o			
8.17 Grind a vertical surface.....			x	o			
8.18 Grind an angular surface.....				x			
8.110 Grind a slotted part.....					x		
8.111 Cut off a hardened part.....					x		
8.112 Grind a radius.....					x		
8.113 Grind a bevel using sine bar.....					x		
8.114 Step grind.....					x		

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
8.10 Precision Surface Grinding (cont.)							
8.115 Grind surfaces perpendicular using holding devices.....				x			x Instruction
8.116 Use correct magnet chuck and attachments for surface grinder.....		x	o	o			o Additional Practice
8.117 Use brake dresser and crush grinder.....		x	o	o			
8.118 Use ultra precision grinding procedures.....					x		* Advanced Instruction
8.20 Centerless Grinding							
8.21 Select the correct wheels, install, and adjust all safety devices.....					x		
8.22 Dress, true and balance the wheels.....					x		
8.23 Select, set up, and correct work guide and adjust blade height.....					x		
8.24 Through grind parts.....					x		
8.25 In-feed grind parts.....					x		
8.26 End feed grind parts.....					x		
8.27 Crush form grind parts.....					x		
8.28 Use wet or dry grinding methods.....					x		
8.30 Cylindrical Grinding							
8.31 Select the correct wheel and speeds of wheel and table...				x			
8.32 Install the wheel and adjust all safety devices.....				x			
8.33 Dress, true, and balance the wheel.....				x			
8.34 Adjust longitudinal taper on table.....				x			
8.35 Traverse grind a straight diameter.....				x			
8.36 Plunge grind a work piece.....				x			
8.37 Grind to a shoulder.....				x			
8.38 Traverse grind an external taper.....				x			
8.39 Grind between centers.....				x			
8.310 Grind long part with workrests.....				x			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
8.30 Cylindrical Grinding (cont.)							
8.311 Grind a form (dressed on the wheel).....					x		x Instruction
8.312 Set and grind a part on workhead attachments.....				x			
8.313 Grind a part using an internal attachment.....					x		o Additional Practice
8.40 Internal Grinding							
8.41 Select the correct wheel, install, and adjust all safety devices.....					x		* Advanced Instruction
8.42 Dress and true a wheel.....					x		
8.43 Grind internal diameter, straight through.....					x		
8.44 Plunge grind and face a shoulder.....					x		
8.45 Grind an internal taper.....					x		
8.50 Tool and Cutter Grinding							
8.51 Select the correct wheel, speeds, feed, and angles.....					x		
8.52 Dress, true, and balance a wheel.....					x		
8.53 Select and set up proper workrest to grind parts with proper primary and secondary clearance.....					x		
8.54 Grind horizontal mill cutter.....					x		
8.55 Grind cylindrical part between centers.....					x		
8.56 Taper grind a cutter.....					x		
8.57 Grind a form tool.....					x		
8.58 Grind a step drill.....					x		
8.59 Sharpen a reamer using the peripheral method.....					x		
8.510 Grind ends and sides of an endmill with cup wheel.....				x			
8.511 Grind a stagger tooth cutter.....				x			
8.60 Bench and Pedestal Grinding							
8.61 Select the correct wheel and install.....				x			
8.62 Dress and true the wheel.....	x	o	o	o			

	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
8.60 Bench and Pedestal Grinding (cont.)							
8.63 Set workrest and spark arrestor properly	x	o	o	o			x Instruction
8.64 Sharpen twist drills by freehand method			x	o			
8.65 Sharpen a tool bit (freehand)	x	o	o	o			o Additional Practice
8.66 Deburr parts	x	o	o	o			
8.67 Sharpen chisels, punches, and screwdrivers	x	o	o	o			
8.68 Use wire brush	x	o	o	o			* Advanced Instruction
8.70 Buffing and Polishing							
8.71 Buff a flat surface		x	o	o			
8.72 Buff a cylindrical surface		x	o	o			
8.73 Buff to a shoulder		x	o	o			
8.74 Buff a contoured surface		x	o	o			
8.75 Select proper compounds for finishes		x	o	o			
8.80 Lapping and Honing (Hand and Machine)							
8.81 Select proper lapping compounds and tools					x		
8.82 Properly charge plate					x		
8.83 Lap a cylindrical plug					x		
8.84 Lap a hole					x		
8.85 Lap a flat surface					x		
8.90 Honing							
8.91 Select proper honing speeds and settings					x		
8.92 Select proper honing stones					x		
8.92 Hone holes straight and true					x		
9.00 Specialized Machining Processes							

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
9.10 Profiler or Pantograph							
9.11 Use a profiler					x		x Instruction
9.12 Use a pantograph					x		
9.20 Numerical Controlled Machine							o Additional Practice
9.21 Operate a numerical controlled machine					x		
9.22 Set up a numerical controlled machine					x		* Advanced Instruction
9.30 Electrical Discharge Machine							
9.31 Operate an electrical discharge machine					x		
9.32 Set up an electrical discharge machine					x		
9.40 Jig Borer							
9.41 Set up and operate the jig borer and grinder					x		
10.00 Applied Metallurgy							
10.10 Identification of Materials							
10.11 Identify ferrous metals		x	o	o			
10.12 Identify non-ferrous metals		x	o	o			
10.20 Heat Treatment							
10.21 Harden Metal		x	o	o			
10.22 Anneal metal		x	o	o			
10.23 Temper metal		x	o	o			
10.24 Normalize metal		x	o	o			
10.25 Harden tool steels		x	o	o			
10.30 Testing							
10.31 Test hardness		x	o	o			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
10.30 Testing (cont.)							
10.32 Test tensile strength			x	o			x Instruction
10.33 Test shear			x	o			
10.34 Test for cracks			x	o			o Additional Practice
11.00 Blueprint Reading and Sketching							
11.10 Blueprint Reading							* Advanced Instruction
11.11 Visualize the shape of object	x	*	o	o			
11.12 Determine dimensions	x	*	*	o			
11.13 Interpret specifications	x	*	o	o			
11.20 Sketching							
11.21 Make sketches	x	*	*	*			
11.22 Make working drawings			x	*			
12.00 Math							
12.10 Arithmetic							
12.11 Perform basic operations	x	o	o	o			
12.12 Perform advanced operations				x			
12.20 Algebra							
12.21 Perform basic operations		x	o	o			
12.22 Perform advanced operations				o			
12.30 Geometry							
12.31 Perform basic operations			x	o			
12.32 Perform advanced operations				x			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
12.40 Trigonometry							
12.41 Perform basic operations				x			x Instruction
12.42 Perform advanced operations					x		
12.50 Machinery Handbook							o Additional Practice
12.51 Use the Machinery's Handbook			x	*			
13.00 Welding							* Advanced Instruction
13.10 Oxyacetylene							
13.11 Assemble and set up torch				x			
13.12 Perform soldering operations				x			
13.13 Perform brazing operations				x			
13.14 Perform welding operations				x			
13.15 Perform cutting operations				x			
13.20 Arc							
13.21 Set up equipment				x			
13.22 Select electrode				x			
13.23 Perform welding operations				x			
14.00 Other (please specify)							
15.00 Communications							
15.10 Listening							
15.11 Listen to get meaning	x	o	o	o			
15.12 Listen to get information	x	o	o	o			

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
15.10 Listening (cont.)							
15.13 Listen to get facts in reports	x	o	o	o			x Instruction
15.14 Listen to understand a person	x	o	o	o			
15.15 Listen to share feelings	x	o	o	o			o Additional Practice
15.20 Talking							
15.21 Talk to instruct			x	o			
15.22 Talk to report on work progress, events, meetings			x	o			* Advanced Instruction
15.23 Talk to describe tasks to be performed, equipment to use			x	o			
15.24 Talk to solve problems, convince of feasibility, technical reports			x	o			
15.25 Talk to get ideas across, persuade, change behavior			x	o			
15.30 Graphic Interpretations							
15.31 Interpret freehand sketches to get meaning	x	*	o	o			
15.32 Interpret working/engineering drawings to get information	x	*	o	o			
15.33 Interpret charts to aid understanding of data			x	*			
15.34 Interpret diagrams to get understanding			x	*			
15.35 Interpret graphs to study variations in data					x		
15.36 Interpret maps					x		
15.37 Interpret pictures	x						
15.40 Graphic Presentations							
15.41 Develop freehand sketches to clarify verbal explanations			x				
15.42 Prepare drawings to express ideas				x			
15.43 Prepare charts to organize ideas					x		
15.44 Develop diagrams to explain or describe action or movement					x		
15.45 Prepare graphs to explain variations in data					x		
15.46 Draw maps					x		
15.47 Select or draw pictures					x		

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	1st Quarter TI/CC	2nd Quarter TI/CC	3rd Quarter TI/CC	4th Quarter TI/CC	Additional Education TI/CC		COMMENTS
15.50 Reading							
15.51 Read instructions and work orders	x	o	o	o			x Instruction
15.52 Read technical journals				x			
15.53 Read technical reports				x			o Additional Practice
15.54 Read memos	x	o	o	o			
15.60 Writing							* Advanced Instruction
15.61 Write work orders, procedural directions					x		
15.62 Write maintenance reports, progress reports					x		
15.63 Write technical reports					x		
15.64 Write memos					x		

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	1st Qtr., TI/CC	2nd Qtr., TI/CC	3rd Qtr., TI/CC	4th Qtr., TI/CC	Additional Educational TI/CC		
16.00 Science							
16.10 Units and Measurements							
16.11 Identify units of length, weight and volume	x						X Instruction
16.12 Estimate the length and weight of objects in metric unit	x						0 Add'l. Practice
16.13 Convert from inches to mm or cm and from lb. to kg.	x						
16.14 Convert from in^3 to cm^3		x					N/A Not Applicable
16.15 Perform measurements using British or metric machinists rules	x						
16.16 Perform measurements using British or metric micrometer calipers	x						
16.17 Perform measurements using British or metric venier calipers	x						
16.18 Calculate the volume and surface area of geometric solids				x			
16.19 Use the correct number of significant figures				x			
16.110 Estimate error in measurements and calculations					x		
16.20 Properties of Materials							
16.21 Use tables of density, specific gravity, and tensile strength					x		
16.22 Read gauges - barometers, hydrometers, scales or balances					x		
16.23 Make measurements to determine density or specific gravity					x		
16.24 Make measurements to determine tensile strength					x		
16.25 Apply terms relating properties of materials - density, specific gravity, tensile strength, malleability, ductility, viscosity, hardness, brittleness				x			

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		1st Qtr., TI/CC	2nd Qtr., TI/CC	3rd Qtr., TI/CC	4th Qtr., TI/CC	Additional Education TI/CC		
	16.26 Use formula for density, specific gravity, and stress					x		X Instruction
	16.27 Calculate temperature, volume, pressure changes in a gas					x		O Add'l. Practice
	16.28 Relate densities to buoyancy and flotation of a substance or body in a fluid medium					x		N/A Not Applicable
	16.29 Follow directions, both oral and written, from lab experiences					x		
	16.210 Graph and interpret graphs					x		
16.30	Mechanics							
	16.31 Measure the power output of a rotating shaft				x			
	16.32 Determine the efficiency of a machine				x			
	16.33 Determine the energy required to do a given job				x			
	16.34 Calculate velocity, distance or time					x		
	16.35 Calculate acceleration, change in velocity or time					x		
	16.36 Identify all forces acting on a body					x		
	16.37 Determine force required to start or stop a body					x		
	16.38 Identify causes of inefficiency in a machine					x		
16.40	Heat							
	16.41 Select correct thermometric device					x		
	16.42 Use a thermometeric device to determine temperature					x		
	16.43 Calculate thermometer					x		
	16.44 Calculate linerar expansion and apply to job at hand					x		
	16.45 Calculate volume expansion of materials and apply to job at hand					x		
	16.46 Calculate or estimate heat absorbed and given up due to a temperature change					x		

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	1st Qtr., TI/CC	2nd Qtr., TI/CC	3rd Qtr., TI/CC	4th Qtr., TI/CC	Additional Education TI/CC	
16.47 Calculate or estimate heat produced in a mechanical operation					x	
16.50 Light and Sound						
16.51 Determine the efficiency of a light fixture						N/A
16.52 Layout a simple lighting system						N/A
16.53 Predict the results of additive color mixing						N/A
16.54 Predict the results of subtractive color mixing						N/A
16.55 Determine the reverberation time of a room						N/A
16.56 Analyze the performance of a loud speaker						N/A
16.57 Use meters and determine decibel levels				x		
16.58 Determine use and installation of sound absorbers				x		
16.59 Measure light intensity				x		
16.60 Tasks in Electricity and Magnetism						
16.61 Install meters and take readings					x	
16.62 Set up simple circuits					x	
16.63 Test with an ohmeter					x	
16.64 Convert joules to foot-pounds						N/A
16.65 Convert joules to calories						N/A
16.66 Convert watts to horsepower					x	
16.67 Determine cost of electrical energy used					x	
16.68 Replace blown fuses					x	
16.69 Determine wire size					x	
16.610 Build an electromagnet					x	
16.611 Build an induction coil					x	
16.612 Build and charge a lead storage battery					x	
16.613 Build and use a transformer					x	
16.614 Build an induction heater (furnace)					x	
16.615 Rectify A.C.					x	

X Instruction

O Add'l. Practice

N/A Not Applicable

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	1st Qtr., TI/CC	2nd Qtr., TI/CC	3rd Qtr., TI/CC	4th Qtr., TI/CC	Additional Education TI/CC		
16.616 Use a capacitor to reduce switch sparking					x		X Instruction
16.617 Use a variable resistor to control current					x		
16.618 Use an oscilloscope						N/A	O Add'l.
16.619 Determine state of battery with a hydrometer						N/A	Practice
16.620 Use Ohm's law to find resistance						N/A	
16.621 Build and use a relay						N/A	N/A Not
16.622 Build on A.C. Generator						N/A	Applicable
16.623 Build an electric motor						N/A	
16.624 Build a copper-zinc cell						N/A	
16.625 Ground an electrical device						N/A	
16.626 Determine the impedance of a coil						N/A	
16.627 Map the lines of force of a magnet						N/A	
16.628 Determine compound resistances						N/A	
16.629 Determine how voltages combine						N/A	
16.630 Determine how currents combine						N/A	
16.631 Determine that like charges repel, etc.						N/A	
16.632 Determine the power used by a lamp, etc.						N/A	
16.633 Find the resistivity of a metal						N/A	
16.634 Determine the electrical equivalent of heat						N/A	
16.635 Find the horsepower of a motor					x		
16.636 Use the laws of transformers						N/A	
16.637 Build a voltmeter or ammeter						N/A	
16.638 Find the field lines around a current-carrying wire						N/A	
16.70 Auxillary							
16.71 Plot a graph					x		
16.72 Read a graph					x		
16.73 Read diagrams and charts (pie charts and histograms, for example)					x		

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	1st Qtr., TI/CC	2nd Qtr., TI/CC	3rd Qtr., TI/CC	4th Qtr., TI/CC	Additional Education TI/CC
16.74 Perform the four basic arithmetic functions		x			
16.75 Extract a square root			x		
16.76 Add inverses			x		

MACHINIST COMPETENCIES

This list of competencies identifies major abilities expected of the graduate of the machinist curriculum. One competency statement is given for each subject, along with suggested criteria for evaluating the persons ability to perform the stated competency. For more detailed competency statements by job level refer to the section titled Job Descriptions/ Job Competencies.

MACHINIST COMPETENCIES

Subject (Task)	Competency	Criterion Measure
1. Orientation	1. Select and demonstrate the switching on and off of the master power switch and demonstrate the proper route of evacuation from a location in the shop.	1. The switch will be the correct power switch. The switch will be completely off in the off position. The evacuation route will be the safest and quickest.
2. Safety	2. Given a controlled fire, select and demonstrate the proper use of a fire extinguisher. Given a pair of safety glasses, clean and adjust to fit the person.	2. The fire extinguisher will be correct for the type of fire. The fire will be extinguished. The safety glasses will be free of spots or smudges. The safety glasses will fit the student without sliding down or hurting the nose or ears.
3. First Aid	3. Given a simulated accident victim, clean and bandage wound, give mouth to mouth resuscitation, stop bleeding, apply splint, wash out eyes, or stimulate for cardiac arrest as directed.	3. The wound area will be clean. The bandage will be applied properly. The technique will be correct for mouth to mouth resuscitation. The pressure point locations will be correct. The splint will be applied properly. The technique of eye washing will be correct.
4. Hand Tools	4. Given an assembly, disassemble and assemble demonstrating the proper selection, use, care, and storage of hand tools.	4. Tool selection will be correct as to type and size. Tools will be clean. Tools will be stored properly and in correct location.

MACHINIST COMPETENCIES

Subject (Task)	Competency	Criterion Measure
5. Measuring Tools	5. Given a part, select the correct measuring instrument and measure to the required accuracy as specified on the blueprint. Also demonstrate the proper care and storage of measuring tools.	5. Instrument selection will be correct in accordance with accuracy required. Instrument reading will be correct within the tolerance. Instruments will be clean and stored in proper location.
6. Layout Work	6. Given a work piece and blueprint, select the proper layout tools and materials and layout line as specified on blueprint.	6. Work piece to be clean and free of burrs. Layout dye will be distributed evenly and in correct location. Lines will be within tolerance as specified on blueprint. Lines will be precise and clear (no double lines or run overs). Punch marks will be located properly. Tools will be cleaned and returned to proper storage location.
7. Hand Cutting Tools	7. Given work pieces and blueprints select, use and properly care for the hand cutting tools to perform the operations as required by the blueprint.	7. Dimensions will be within tolerance. Finishes will be within tolerances. Tools will be sharp. Tools will be clean Tools will be stored properly.
8. Hand Assembly and Fitting	8. Given an assembly and blueprint, assemble the parts using the proper fasteners, correct fits and finishes.	8. Fasteners to be correct type and size. Fits to have proper allowances. Finishes to be within specifications.

MACHINIST COMPETENCIES

Subject (Task)	Competency	Criterion Measure
9. Portable Power Tools	9. Given work pieces and blueprints, drill, grind and chip work piece using power tools.	9. Tools will be sharp and have proper clearance and cutting angles. Dimensions will be within tolerance. Finishes to be within tolerance.
10. Supplemental Operations	10. Given work pieces and blueprints, polish, broach, assemble with rivets, and extract screws and taps as required by the blueprint by selecting, using and caring for the tools.	10. Finishes to be within tolerance as specified by print. Dimensions to be within tolerance as specified by print. Screws and top to be removed without damage to existing threads. Rivets to be headed properly. Parts assembled with rivets to be tight.
11. Inspection	11. Given finished machined parts, they will be inspected for correct tolerances, assembly, and surface finish.	11. All surfaces to be free of burrs and to print RMS All dimensions shall be to print specifications. All parts should assemble per print specifications.

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Subject (Task)	Competency	Criterion Measure
12. Reciprocating and Continuous Band Cut-Off Saw	12. Given a length of material to cut off and the number of parts to be cut, parts will be cut to print-length specifications.	12. Select proper type saw for the particular job. Select saw blades in accordance to the type and hardness of material being sawed. Speed and feeds should also be selected in accordance to the type and hardness of material being used. Finishes and sizes should be to print specifications.
13. Contour Band Saw	13. Select blade from bulk stock for assigned project, weld blade, install blade on machine; select speed/feed, and saw part using feed control and work control.	13. Inspect size of blade for correct contours. Inspect blade for wear. Inspect part as to specification to print.

Subject (Task)	Competency	Criterion Measure
14. Abrasive Saw	14. Cut part or parts to be machined to specifications using an abrasive saw.	14. No burn at cut. Keep excess stock to a minimum per print. Use correct width and abrasive wheel. Use proper holding devices and guards.
15. Hand Feed Drill	15. Given a part of an assembly, drill a series of holes as per print with the proper size, location, and finish using a hand feed drill.	15. See that all hole sizes are within print tolerances. See that all hole locations are within print tolerances. Finishes should meet print RMS. Holes should be free of burrs. Holes should align themselves with mating part of proper assembly.
16. Power Feed Drill	16. Given a part of an assembly to drill, tap and ream, perform the required operations maintaining quality as per print using a power feed drill.	16. The sizes and locations are to be within the drawing tolerances stated. Finishes are to be within desirable R M S stated on drawing by using correct feeds. The holes should be free of burrs and should align themselves for proper assembly with mating parts.

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Subject (Task)	Competency	Criterion Measure
17. Engine Lathe	17. Given a part to turn, face, chamfer, undercut, center drill, thread, etc., perform the above operations on an engine lathe as per print.	17. Diameter sizes and lengths are to be within tolerances stated on drawing. Finishes are to be free of burrs, and of quality to meet required RMS stated on working drawing. Concentricity of each diameter held within print specification.
18. Turret Lathes	18. Given a part to perform all necessary operations required by a turret lathe, set up tooling and stops and perform the required operations to complete parts to specifications.	18. Diameter sizes and lengths are to be within print specified tolerances. Finishes are to be of quality to meet required RMS. Concentricity of each diameter is to be held within print specifications. Parts are to be free of burrs and, unless otherwise stated, all sharp edges broken. Tools should be placed in machine in such an order, and feeds and speeds set, to give maximum production and required print finish.
19. Milling Machines	19. Given a part to be milled, slotted, keyed, dovetailed, drilled, reamed, and a blueprint of part, perform the above operations as per print on a milling machine to the specifications and tolerances given.	19. Fixtures, tools, speeds and feeds are to be chosen to give maximum production and finishes per print RMS. Dimensions are to be within print tolerances. Surfaces are to be free of burrs and all sharp edges broken as per print specification.

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Subject (Task)	Competency	Criterion Measure
20. Milling Machine (Special)	20. Given a part and/or blueprint of completed part, complete the special milling operations to print specifications.	20. Finished part size (slots, widths, depths and locations, etc.) should be within print specifications. Finishes should be of quality to meet print RMS. Proper cutters are to be used to achieve maximum production and the desired finishes to print specifications. Parts should be free of burrs and, unless otherwise stated, sharp edges broken. Fixtures should be placed on machine for proper holding or workpiece.
21. Shaper-Planer	21. Given a part, select the correct tools, set-up, operate and complete a shaper-planer operation (horizontal, vertical, or angular) to the specified tolerances of the drawing.	21. The finished shaper-planer operation will maintain parallel and perpendicular surfaces. Finish will be to the required RMS or AA. The correct fractional and decimal tolerances will be maintained. The part will be free of burrs and sharp edges.
22. Precision Grinding	22. Given a grinding machine, lubricate it according to the service instructions, mix and apply coolant, and clean the machine properly.	22. The lubrication oil will be identified as to the proper viscosity as prescribed by the manufacturer. The coolant mixture will be sufficient to keep the part cool and provide lubrication of the cutter. The cleaning medium will be an OSHA approved material and disposed of properly.

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Subject (Task)	Competency	Criterion Measure
23. Precision Grinding	23. Given a grinding machine, locate and identify the main switch and all auxiliary power switches.	23. The grinder main power supply will be learned. The wheel motor switch will be identified. The work head switch will be identified. The table travel switch will be identified.
24. Precision Grinding	24. Given a grinding machine, select and mount the grinding wheel in the prescribed manner.	24. The grinding wheel will be identified by the markings. The grinding wheel will be checked for cracks. The grinding wheel will be the proper size for the machine.
25. Precision Grinding	25. Given a grinding machine, dress the wheel according to the job requirement.	25. The dressing tool will be chosen and used properly. The dressed wheel will have the desired finish to cut properly. The wheel will produce minimum vibration in the grinding operation.
26. Precision Grinding	26. Given the necessary equipment, balance the grinding wheel to the prescribed limit.	26. The balanced wheel will be within the prescribed limit. The wheel will be mounted securely to the holder using the correct blotters. The wheel will be mounted to the grinder being careful not to damage it.

Subject (Task)	Competency	Criterion Measure
27. Surface Grinding	27. Given a project, select the proper grinding wheel and complete a surface grinding operation to the specific tolerance of the drawing.	27. The finished surface grinding operation will maintain, parallel and perpendicular surfaces. Finish to the required RMS or AA. Maintain the correct fractional and decimal tolerances. Be free of burrs and sharp edges.
28. Centerless Grinding	28. Given a project part, select the correct grinding and regulating wheel and complete a centerless grinding operation to the specific operation on the drawing.	28. The finished centerless grind part will maintain finish to the prescribed RMS or AA. Roundness to close tolerance normally expected from centerless grinding. No chatter marks or flat spots on the work.
29. Cylindrical Grinding	29. Given a project part select the proper grinding wheel and complete a cylindrical grinding operation to the specified tolerance on the drawing.	29. The finished cylindrical ground part will maintain straight and round surfaces on the diameter of the work. Finish as specified. Tolerance as specified. Part to stay sufficiently cool to prevent annealing or warping.

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Subject (Task)	Competency	Criterion Measure
30. Tool and Cutter Grinder	30. Given a group of cutters, select the proper grinding wheel and set up and sharpen several different types of cutting tools to the required specification.	30. The finished ground tool should have the prescribed clearance angles. Cutting edges will be ground to the specified finish or better. Completed cutter will be coated or wrapped to protect cutting edges and provide safe handling.
31. Off Hand Grinding	31. Given a workpiece (drill or tool blank), select the proper grinding wheel and complete an off-hand grinding operation to the dimensions on design.	31. The finished ground part should maintain the prescribed clearance angles. Cutting edges will be ground to the required finish. Tool rest on grinder will be set a maximum of 1/8" from wheel.
32. Buffing and Polishing	32. Given a project part, select the proper wheel and compound, complete a buffing/polishing operation to the desired finish.	32. The finished project will be within the minimum decimal and fractional tolerance and buffing and polishing. Finish to the specified finish or better. Part to be kept sufficiently cool to reduce annealing and warping.
33. Lapping (Hand & Machine)	33. Given a project part, select the proper lapping compound and lap the project part to the specified tolerance of the drawing.	33. The finished lapped part will be flat to tolerance specified. The finished lapped part will blue fit to total area as specified.

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Subject (Task)	Competency	Criterion Measure
34. Honing	34. Given a project part, select the proper honing stone and hone a hole to the size and finish desired.	34. The finished honed part will be round to specified tolerance. The finished honed hole will meet the specified size tolerance. The finished honed hole will be finished to specified RMS or better. The part will be free of burrs and sharp edges.
35. Profiler or Pantograph	35. Given a project of engraving a name plate, or three dimensional object, set up, select tools, set speeds and feeds and complete specifications to sample, sketch or drawing.	35. The part will meet specifications as to finish, dimensions and overall appearance.
36. Numerically controlled machining	36. Drill, tap and mill a slot in a plate to print or sketch specifications using set up procedures, selecting tools, speeds, and feeds, loading and unloading tapes and inspect the part for conformance to specifications.	36. Inspect plate for hole size, tapped hole, length and width of slot and position of holes and slot in plate. Check for overall appearance and finish.
37. Electrical Discharge Machine	37. Select a part, set up the machine, select electrodes, set machine for current rate, select coolant, feed rate and machine part to print.	37. Inspect part for correct dimensions and specifications according to print.
38. Jig Borer and Grinder	38. Given a project and rough machine mold cavity, set up machine, select feed and speed and finish grinding.	38. The part will meet specifications as to finish, dimensions and overall appearance.

MACHINIST COMPETENCIES

Subject (Task)	Competency	Criterion Measure
39. Identification of Materials	39. Identify a piece of ferrous metal by finish, spark test and color code. The student will identify a piece of non-ferrous metal by magnetic test, corrosion appearance, color code and material appearance.	39. Compare ferrous steel with a positive known sample. Compare non-ferrous part with a positive known sample, test with magnet and perform identification tests.
40. Heat Treatment	40. Given specimen to be treated, perform the heat treatment required to achieve the specified results.	40. By use of spark test, chemical test, and color code examination-determine the structure of materials. Charts or tables should be used to determine exact temperatures to use for the particular structure being heat treated. Tempering temperatures, and length of time in the furnace (as stated by the tables or charts) should be used to achieve correct hardness stated on drawings.
41. Testing	41. Given known test specimens, test to determine structure, hardness and tensile strength.	41. Inspect material to insure tests are correctly administered. Clean part for accurate test. Visual checks for cracks and bends. Use correct equipment for testing. Use tables and charts. File test.

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MACHINIST COMPETENCIES

Subject (Task)	Competency	Criterion Measure
42. Blueprint Reading	42. Given a print or sketch, read the blueprint to determine dimensions, specifications, tolerances, and shop notes for the part.	42. Print is read correctly.
43. Sketching	43. Sketch a part using lines, making sketches of necessary views, dimensions, specifications, limits and tolerances, shop notes and title block information.	43. Compare part to sketch for neatness and to determine if the part can be machined from sketch.
44. Arithmetic	44. The student will perform functions of arithmetic by applying it to tasks in the shop, classroom and on tests and examinations.	44. Application of arithmetic in the shop and test grades.
45. Algebra	45. Perform functions in basic algebra with single unknowns.	45. Use basic algebra in shop.
46. Geometry	46. Perform basic geometric functions.	46. Applies concepts using geometric shapes in the shop.
47. Trigonometry	47. Perform basic trigonometric functions with single unknown.	47. Applies basic trigonometric concepts in shop.
48. Use of Machinery's Handbook	48. Use the Machinery's Handbook by applying tables, charts, formulas and technical data in daily use for shop projects.	48. Uses handbook to find appropriate information.

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Subject (Task)	Competency	Criterion Measure
49. Oxyacetylene Welding	49. Select a soldering project, prepare the surface, select the flux, select filler material and solder the project. Select a brazing project, prepare the surface, select the flux, select filler material, and braze the project. Select a welding project, prepare the workpiece, select rod and weld the project. Cut object according to print specification.	49. The student will select a project, prepare the material, select filler material and weld the part. Inspect flow of filler material for adherence, excessive build-up weak spots and appearance. The student will set up torch for cutting operation, cut and prepare weld test plates. Inspect weld test plates for correct angles, size and finish. Inspect tightness of fitting, setting of gauges, size of tip and lighting the torch. Take project apart and inspect for cleanliness of part, pits in filler material and amount of filler material used. Inspect for flow of filler material, adherence of filler material to part, and test project for strength.
50. Arc Welding	50. Set an arc welding machine for correct current, ensure ground connection positive, wear proper clothing, take safety precautions, strike an arc, and weld a part.	50. The student will select the proper electrode by using a print with welding specifications, as to size and grade. The student will prepare material for weld test plate, weld plate, clean slag, remove back up strip, saw coupons, grind surfaces, and chamfer. Inspect for pits, slag and form

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Subject (Task)	Competency	Criterion Measure
		coupons to specifications. Inspect for cracks and penetration of filler material to parent metal.
51. Listening and Talking	51. Listen, understand and interpret instructions and theory in the classroom and shop.	51. Demonstrate listening & understanding by correctly performing task and by instructing others properly. Ask the opinion of instructor on various ways to accomplish tasks.
52. Graphic Interpretations and Presentations	52. Use different methods of graphic interpretations and presentations.	52. Give a part the student should be able to sketch freehand views. Student will display his ability to interpret drawings on illustrations by performing matching task to blueprint specifications.
53. Reading and Writing	53. Read and write technical reports, articles and instructions.	53. Read technical magazines and follow instructions. Write procedure sheets and work order procedures.

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Appendix K

TASK ANALYSIS

ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Introduction

TASK: (No. 1.1) Orientation

COMPETENCY: Select and demonstrate the switching on and off of the master switch and demonstrate the proper route of evacuation from a location in the shop

CRITERION MEASURE:
The switch will be the correct power switch
The switch will be completely off in the off position
The evacuation route will be the safest and quickest

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Switch On and Off Master Power Switch II. Drill Evacuation Route	I. Location of Switch (Master) II. All Exits (a) Route to exits (b) Isle markings	Orientation I. Switches (a) Care (b) Safety (c) Interest II. Exits

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Introduction

TASK: (No. 1.2) Safety

COMPETENCY: Given a controlled fire, select and demonstrate the proper use of a fire extinguisher
Given a pair of safety glasses, clean and adjust to fit the person

CRITERION MEASURE:
The fire extinguisher will be correct for the type of fire
The fire will be extinguished
The safety glasses will be free of spots or smudges
The safety glasses will fit the student without sliding down or hurting the nose or ears

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Use Fire Extinguisher	I. Fire Extinguisher (a) Location (b) Types (c) Uses (d) Refilling	Safety I. Fire Extinguisher (a) Location (b) Care of
II. Clean and Adjust Safety Glasses and Goggles for Use	II. Safety Glasses and Goggles (a) Types (b) Cleaning methods (c) Adjustments	II. Safety Equipment (Personal) (a) Cleaning (b) Storage (c) Adjustments
III. Follow Safety Rules and Regulation in the Shop	III. Safety Rules and Regulations	

ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Introduction

TASK: (No. 1.3) First Aid

COMPETENCY: Given a simulated accident victim, clean and bandage wound, give mouth to mouth resuscitation, stop bleeding, apply splint, wash out eyes, or stimulate for cardiac arrest as directed

CRITERION MEASURE:
The wound area will be clean
The bandage will be applied properly
The technique will be correct for mouth to mouth resuscitation
The pressure point locations will be correct
The splint will be applied properly/ The technique of eye washing will be correct
The technique of heart stimulation will be correct

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Clean and Bandage Wound	I. Bandages (a) Types (b) Application	First Aid I. Need For
II. Mouth to Mouth Resuscitation	II. Mouth to Mouth Resuscitation (a) Reason for (a) When to use (b) Time for (b) How to use	II. Accident Prevention
III. Stop Bleeding	III. Tourniquet (When to apply)	
IV. Apply Splint	IV. Splint (a) Types of fracture (b) How to apply	
V. Wash out Eyes	V. Eyes (a) Types of washes (b) How to wash	
VI. Proper Stimulant for Cardiac Arrest		

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.1) Hand Tools

COMPETENCY: Given an assembly, disassemble and assemble demonstrating the proper selection use, care, and storage of hand tools

CRITERION MEASURE:
Tool selection will be correct as to type and size
Tools will be clean
Tools will be stored properly and in correct location

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Use hand Tools (Basic)	I. Basic Hand Tools (a) Types (b) Care (c) Storage (d) How to use (e) Safe practices	Hand Tools I. Proper Use of Hand Tools II. Cleaning of Hand Tools III. Maintenance of Hand Tools
II. Select and Use Hand Tools (Specialized)	II. Specialized Hand Tools (a) Types (b) Care (c) Storage (d) How to use (e) Safe practices	IV. Storage of Hand Tools V. Safety of Hand Tools VI. Housekeeping VII. Relation to Major Area of Study VIII. Neat Appearance

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.2) Measuring Tools

COMPETENCY: Given a part, select the correct measuring instrument and measure to the required accuracy as specified on the blueprint. Also demonstrate the proper care and storage of measuring tools

CRITERION MEASURE:
Instrument selection will be correct in accordance with accuracy required
Instrument reading will be correct within the tolerances
Instruments will be clean and stored in proper location

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Use Semi-precision Tools	I. Semi-precision Measuring Tools (a) Types (b) Care (c) Storage (d) Use	Measuring Tools I. Proper Use of Measuring Tools II. Cleaning of Measuring Tools
II. Select and Use Precision Tools	II. Precision Measuring Tools (a) Types (b) Care (c) Storage (d) Use	III. Maintenance of Measuring Tools IV. Calibration of Measuring Tools
III. Select and Use Metric Measuring Tools	III. Metric Measuring Tools (a) Types (b) Care (c) Storage	V. Storage of Measuring Tools VI. Safety of Measuring Tools VII. Housekeeping VIII. Relation to Major Area of Study

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.3) Layout Work

COMPETENCY: Given a work piece and blueprint, select the proper tools and materials and layout line as specified on blueprint

CRITERION MEASURE:
Work piece to be clean and free of burrs
Layout dye will be distributed evenly and in correct location
Lines will be within tolerance as specified on blueprint
Lines will be precise and clear (no double lines or run overs)
Punch marks will be located properly
Tools will be cleaned and returned to proper storage location

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Prepare Work Piece Layout	I. Preparing Work Piece (a) Descaling and deburring (b) Degreasing (c) Types of layout dyes and application. (d) Safety precautions	Layout Work I. Layout Work for Proper Care of Tools II. Work Preparation III. Safety IV. Quality of Work V. Housekeeping
II. Select and Use Layout Tools and Equipment	II. Layout Tools and Equipment (a) Types (b) Care (c) How to Use (d) Read blueprints (e) Math	
III. Layout Work Piece	III. Layout Work Piece (a) Drawing interpretation (b) Application of layout fluid (c) Selection of reference surface (d) Precautions	
IV. Check Layout	IV. Check Layout (a) Measurement (b) Use of layout tools and equipment	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.4) Hand Cutting Tools

COMPETENCY: Given work pieces and blueprints, select, use, and properly care for the hand cutting tools to perform the operations as required by the blueprint

CRITERION MEASURE:
Dimensions will be within tolerances
Finishes will be within tolerances
Tools will be sharp
Tools will be clean
Tools will be stored properly

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select Threading Tools	I. Basic Hand Threading Tools (a) Types (b) Care (c) Storage (d) How to use	Hand Cutting Tools I. Proper Use of Hand Cutting Tools
II. Select and Use Hand Reamers	II. Basic Hand Reamers (a) Types (b) Care (c) Storage (d) How to use	II. Cleaning of Hand Cutting Tools
III. Select and Use Chipping and Gouging Tools	III. Basic Chipping and Gouging Tools (a) Types (b) Care (c) Storage (d) How to use	III. Maintenance of Hand Cutting Tools IV. Storage of Hand Cutting Tools V. Sharp Tool
IV. Select and Use Files and Scrapers	IV. Basic Files and Scrapers (a) Types (b) Care (c) Storage (d) How to use (e) Proper method of holding for best results (f) Use of file card	VI. Safety VII. Quality of Work

ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.5) Hand Assembly and Fitting

COMPETENCY: Given an assembly and blueprint, assemble the parts using the proper fasteners, correct fits and finishes

CRITERION MEASURE:
Fasteners to be correct type and size
Fits to have proper allowances
Finishes to be within specifications

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Assemble Parts with Screws and Nuts	I. Fasteners (a) Types (b) Drivers (c) Uses	Hand Assembly and Fitting I. Proper Use of Tools in Hand Assembly and Fitting
II. Fit Parts Using Shrink Force and Running Method	II. Fits (a) Shrink (b) Force (c) Running (d) Proper fits using Prussian blue	II. Safety III. Housekeeping IV. Quality of Work V. Maintenance of Tools
III. Lap Parts	III. Laps (a) Types (b) Uses (c) Lapping compounds (grits)	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.6) Portable Power Tools

COMPETENCY: Given work pieces and blueprints, drill, grind and chip work piece

CRITERION MEASURE:
Tools will be sharp and have proper clearance and cutting angles
Dimensions will be within tolerance
Finishes to be written tolerance

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Use Hand Drill	I. Hand Drills (a) Types (b) Uses and care (c) Speeds (d) Drills and other cutting tools	Portable Power Tools I. Proper Use of Tools II. Cleaning of Portable Power Tools
II. Select and Use Hand Grinders	II. Hand Grinders (a) Types (b) Use and care (c) Grinding wheels and brushes	III. Maintenance of Portable Power Tools IV. Storage of Portable Power Tools
III. Select and Use Chipping Hammer	III. Chipping Hammers (a) Types (b) Use and care (c) Tools	V. Safety of Portable Power Tools VI. Quality of Work VII. Housekeeping

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.7) Supplemental Operations

COMPETENCY: Given work pieces and blueprints, polish, broach, assemble with rivets and extract screws and taps as required by the blueprint by selecting, using and caring for the tools

CRITERION MEASURE:
Finishes to be within tolerance as specified by print
Dimensions to be within tolerance as specified by print
Screws and top to be removed without damage to existing threads
Rivets to be headed properly
Parts assembled with rivets to be tight

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Use Hand Polisher	I. Hand Polisher (a) Types (b) Care and uses (c) Compounds	Supplemental Operations I. Proper Use of Tools
II. Select and Use Hand Broaching Tool	II. Broaches (a) Types (b) Care and uses	II. Cleaning III. Maintenance IV. Storage
III. Assemble with Rivets	III. Rivets (a) Types (b) Tools (c) Installation	V. Safety VI. Quality of Work
IV. Extract Screws and Taps	IV. Tap and Screw Extractors (a) Types (b) Uses and care	VII. Enthusiasm VIII. Pride IX. Imagination X. Design XI. Relation to Other Operations

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Bench Work

TASK: (No. 2.8) Inspection

COMPETENCY: Given finished machined parts, they will be inspected for correct tolerances, assembly, and surface finish

CRITERION MEASURE:
All surfaces to be free of burrs and to print RMS
All dimensions shall be to print specifications
All parts should assemble per print specifications

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up Equipment	I. Set up Equipment (a) Use (b) Care (c) Types	Inspection I. Proper Use of Tools and Equipment and Measuring Instruments
II. Select and Use Inspection Tool and Gauges	II. Tool and Gauges (a) Use (b) Care (c) Types	II. Cleaning III. Adjustment and Calibrations IV. Storage
III. Select and Use Mechanical Testing Equipment	III. Mechanical Testing Equipment (a) Use (b) Care (c) Types	V. Safety VI. Reports VII. Design VIII. Housekeeping

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Power Sawing

TASK: (No. 3.1) Reciprocating and continuous band cut-off saw

COMPETENCY: Given a length of material to cut off and the number of parts to be cut, parts will be cut to print length specifications

CRITERION MEASURE: Select proper type saw for the particular job
Select saw blades in accordance to the type and hardness of material being sawed
Speed and feeds should also be selected in accordance to the type and hardness of material being used
Finishes and sizes should be to print specifications

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Install Blade	I. Blades (a) Types (b) Uses and care (c) Feed and speed	Reciprocating and Continuous Band Cut-off Saw I. Proper Use of Machine
II. Clamp Workpiece	II. Workholding Devices (a) Types (b) Uses and care	II. Cleaning
III. Straight Cuts	III. Operation of Machine (a) On-off (b) Feed mech. (c) Coolant (d) Speed control	III. Adjustments IV. Safety V. Blade Storage VI. Maintenance
IV. Angular Cuts	IV. Materials (a) Types (b) Uses	VII. Quality of Work VIII. Return Leftovers into Proper Storage Rack or Bin

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Power Sawing

TASK: (No. 3.2) Contour Band Saw

COMPETENCY: Select blade from bulk stock for assigned project, weld blade, install blade on machine, select speed/feed, and saw part using feed control and work control

CRITERION MEASURE:
Inspect size of blade for correct contours
Inspect blade for wear
Inspect part as to specification to print

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Install Blade	I. Band Blades (a) Types (b) Use and care (c) Feed and speeds	Contour Band Saw I. Proper use of Machine
II. Weld Blade	II. Welding Machine Operation (a) Clamping (b) Welding (c) Annealing (d) Dressing	II. Cleaning III. Adjustments IV. Maintenance V. Blade Storage
III. Saw to Layout (a) Straight line (b) Contour (c) Contour angular	III. Operation of Machine (a) On-off (b) Feed mech. (c) Work clamping (d) Work control (e) Set table	VI. Safety VII. Quality of Work VIII. Housekeeping
IV. Select Proper Material		IX. Return Leftover Stock to Proper Storage Rack or Bin

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Power Sawing

TASK: (No. 3.3) Abrasive Saw

COMPETENCY: Cut part or parts to be machined to specifications

CRITERION MEASURE:
No burn at cut
Keep excess stock to a minimum per print
Use correct width and abrasive wheel
Use proper holding devices and guards

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Mount Abrasive Wheel	I. Abrasive Wheels (a) Types (b) Care and uses (c) Coolants to use	Abrasive Saw I. Proper Use of Machine
II. Clamp Workpiece	II. Workholding Devices (a) Types (b) Care and uses	II. Wheel Protection and Storage III. Adjustments
III. Cut Part to Specification	III. Operation of Machine (a) On-off (b) Feed methods (c) Work clamping methods	IV. Maintenance of Equipment V. Safety VI. Cleaning
	IV. Types of Materials (alloys) to Cut on	VII. Housekeeping VIII. Relation to Other Operations IX. Quality of Work

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Drilling Operations

TASK: (No. 4.1) Hand Feed Drill

COMPETENCY: Given a part of an assembly, drill a series of holes as per print with the proper size, location, and finish

CRITERION MEASURE:
See that all hole sizes are within print tolerances
See that all hole locations are within print tolerances
Finishes should meet print RMS
Holes should be free of burrs
Holes should align themselves with mating part of proper assembly

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select Correct Drill	I. Drills (a) Types & Quality of Drills (Limited) (b) Parts of a Drill (I.D.) Gen. purpose (c) Sizing Methods and Systems (no., letter, fraction, and metric)	Hand Feed Drill I. Care of Tools II. Safety III. Sharp Bits IV. Handling Tools V. Maintenance VI. Storage VII. Speeds VIII. Selection of Tools IX. Pressure Applied
II. Drill a Hole	II. Machines and Accessories (a) Holding devices (b) Speeds (c) Lubricants (d) Drill point geometry	
III. Countersink a Hole	III. Countersinking (a) Types of countersinks (b) Angle required (c) Diameter of hole (d) Speeds (e) Lubricants	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Drilling Operations

TASK: (No. 4.2) Power Feed Drill

COMPETENCY: Given a part of an assembly to drill, tap, ream, and perform the required operations maintaining quality as per print

CRITERION MEASURE: The sizes and locations are to be within the drawing tolerances stated
Finishes are to be within desirable RMS stated on drawing by using correct feeds
The holes should be free of burrs and should align themselves for proper assembly with mating parts

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
See Hand Feed Drill	I. Same as Hand Feed Drill Except Operator Should Know the Following (a) Feeds (inches per revolution) (b) Location and Use of Feed Table II. RMS Gauging (a) Speciman Blocks (b) Profilometer	Power Feed Drills I. Guards II. Sharp Tool III. Tool Handling IV. Storage V. Maintenance VI. Speeds VII. Selection of Tools VIII. Safety IX. Visual Aids X. Housekeeping

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Outline of Instructional Content (Continued)

Skill/Process	Knowledge/Theory	Value/Attitude Concepts
IV. Counterbore a Hole	IV. Counterboring (a) Types of counterbores (b) Sizing methods (c) Speeds (d) Lubricants (e) Depths	
V. Ream a Hole	V. Reaming (a) Types of reamers (b) Sizing (straight or taper) (c) Speeds (d) Lubricants	
VI. Tap a Hole	VI. Tapping (a) Types of taps (b) Thread systems (c) Tap drill sizes (d) Lubricants (e) Tapping attachments (f) Speeds	
VII. Hone a Hole	VII. Honing and Lapping (a) Finish requirements (b) Amount of material to be removed (c) Compounds and material to be used (d) Speeds	
VIII. Lap a Hole	VIII. Gauging (a) Types (b) Uses	NOTE: Sharpening Drills Under Abrasive Machining - Tool & Cutter Grinding
328 IX. Gauge the Operation		329

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Lathe Operations

TASK: (No. 5.1) Engine Lathe

COMPETENCY: Given a part to turn, face, chamfer, undercut, center drill, thread, etc., perform the above operations as per print

CRITERION MEASURE:
Diameter sizes and lengths are to be within tolerances stated on drawing
Finishes are to be free of burrs and of quality to meet required RMS stated on working drawing
Concentricity of each diameter held within print specification

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up Work in Independent Chuck	I. Alignment Procedures; Internal and External (a) Chalk methods (b) Concentric rings (c) Lathe tool (d) Wiggler (e) Dial indicator	Engine Lathe I. Care of Machine II. Lubrication III. Selection of Tool and Accessories
II. Set up Work in Universal Chuck	II. Types of Chuck Jaws	IV. Maintenance
III. Set up Work in Combination Chuck	III. Alignment Procedures (same as independent)	V. Speeds and Feeds
IV. Set up Work in Collets	IV. Types of Collets	VI. Safety
V. Set up Work on a Face Plate	V. Clamping Procedures (balancing)	VII. Visual Aids
VI. Set up Work in Centers	VI. Working Between Centers (a) Types of centers (b) Alignment of centers (c) Type of tool (d) Lubricant of centers	VIII. Guards

Outline of Instructional Content (Continued)

Skill/Process	Knowledge/Theory	Value/Attitude Concepts
VII. Select Proper Speeds and Feeds	VII. Selection of Proper Speeds and Feeds (a) Type of workpiece material (b) Type of cutting tools (c) Feed and speed tables (d) Locations for feed and speed tables (e) Lubricant	
VIII. Select and/or Grind of Cutting Tools	VIII. Selecting and Grinding Tools (a) Type and kind of tools (single, gang) (b) Grinding procedures-special (c) Application of tools (d) Gauging of tools (e) Tool holder (types)	
IX. Perform Turning and Facing Operations	IX. Perform Turning and Facing Operations Selection of Application in Previous Steps One thru Eight	
X. Perform Threading Operations	X. Perform Threading Operations (a) Thread systems (b) Selection and/or grinding of tool (c) Set up operation of machine (d) Gauging and measuring procedures	
XI. Perform Taper Operations	XI. Taper Turning Principles (a) Taper standards (b) Taper turning methods (c) Gauging and measuring of tapers	

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Outline of Instructional Content (Continued)

Skill/Process	Knowledge/Theory	Value/Attitude Concepts
XII. Perform Drilling and Reaming Operations	XII. Drilling and Reaming Principles (a) Types and sizes (b) Types and sizes of boring tools (c) Feeds and speeds	
XIII. Perform Boring Operations	XIII. Boring Principles (a) Types and sizes of boring bars (b) Types and sizes of boring tools (c) Feeds and speeds (d) Lubricants	
XIV. Perform Tool Rest Grinding Operations	XIV. Grinding Principles (a) Proper setup procedures (b) Types of wheels (c) Type of material	
XV. Perform Chamfering Operation	XV. Chamfering Principles (a) Proper setup (b) Speeds and feeds (c) Lubricant (d) Measurement	
XVI. Perform Knurling Operations	XVI. Knurling Principles (a) Types of knurls (b) Patterns and pitches (c) Speed and feed (d) Lubricant	
XVII. Perform Freehand Operations	XVII. Freehand Principles (a) Select type of tool (b) Feed and speed (c) Lubricant	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Lathe Operations

TASK: (No. 5.2) Turret Lathes

COMPETENCY: Given a part to perform all necessary operations required by a turret lathe, set up tooling and stops and perform the required operations to complete parts to specifications

CRITERION MEASURE:
Diameter sizes and lengths are to be within print specified tolerances
Finishes are to be of quality to meet required RMS
Concentricity of each diameter is to be held to within print specifications
Parts are to be free of burrs and, unless otherwise stated, all sharp edges broken
Tools should be placed in machine in such an order and feeds and speeds set to give maximum production and required print finish

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up Rear Turret Tooling and Stops	I. To Set up Turret Lathe (a) Basic steps (common to all first operations of a lathe job) (b) Types and sizes of turret lathes (1) Ram (2) Saddle (3) Vertical screw machine (c) Lubricants (d) Speed and feeds (e) Selecting of tools (f) Stops	Turret Lathe I. Care of Machine II. Housekeeping III. Visual Aids IV. Lubrication V. Selection of Tools and Accessories VI. Speeds and Feeds VII. Safety VIII. Guards
II. Set up Cross Slide Tooling and Stops		
III. Perform Necessary Operations		

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OUTLINE OF INSTRUCTIONAL CONTENT (CONTINUED)

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
IV. Mill Keyways	IV. Milling Keyways (a) Types and sizes of keyways (b) Materials (c) Keyway cutters (d) Standards and tolerances (e) Speeds and feeds (f) Lubricants (g) Safe practice	
V. Drill, Ream, and Bore	V. Drill, Ream, and Bore (a) Types and sizes (b) Materials (c) Index head use and procedures (d) Feeds and speeds (e) Measurements and tolerances (f) Lubricants (g) Safe practices (h) Mathematics 1) Gear ratios 2) Trig. functions on formulas (i) Use of lead charts (Knowledge more important than skills)	
VI. Perform Gear-Cutting Operations (a) Gear (spur) (b) Rack (c) Bevel (d) Helix		

OUTLINE OF INSTRUCTIONAL CONTENT (CONTINUED)

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
VII. Mill T-slots and Dove-tails	VII. Milling T-slots and Dove-tails (a) Types and sizes (b) Materials (c) Feeds and speeds (d) Measurements and tolerances (e) Lubricants (f) Safety procedures VIII. Straddle and Gang Milling Operations (a) Types of cutters (b) Cutter spacing (c) Materials (d) Feeds and speeds (e) Angular tolerances (f) Coolants (g) Safety practices	
IX. Select Correct Speeds and Feeds	IX. Speeds and Feeds	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Milling Machine Operations

TASK: (No. 6.1) Milling Machines

COMPETENCY: Given a part to be milled, slotted, keyed, dovetailed, drilled, reamed, etc., and a blueprint of part, perform the above operations as per print to the specifications and tolerances given

CRITERION MEASURE: Fixtures, tools, speeds, and feeds are to be chosen to give maximum production and finishes per print RMS
Dimensions are to be within print tolerances
Surfaces are to be free of burrs and all sharp edges broken as per print specification

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Mount Milling Cutters	I. Milling Cutters (a) Types (b) Sizes (c) Special use and handling (d) Lubrication	Milling Machine I. Care of Machine II. Housekeeping
II. Select and Mount Workholding Devices	II. Workholding Devices (a) Table (b) Vises (c) Indexing heads (d) Rotary table (e) Fixtures	III. Tool and Cutter Care IV. Visual Aids V. Lubrications VI. Selection of Proper Attachments for Job
III. Mill a Flat Surface; Face, Side, and Radius	III. Milling Flat Surfaces (a) Basic milling principles (b) Conventional milling procedures (c) Climb milling procedures (d) Materials (e) Cutter selections (f) Feeds and speeds (g) Lubricant (h) Safe practice	VII. Speeds and Feeds VIII. Safety

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Milling Machine Operations

TASK: (No. 6.2) Milling Machine (Special)

COMPETENCY: Given a part and/or blueprint of completed part, complete the special milling operations to print specifications

CRITERION MEASURE: Finished part size (slots, widths, depths, locations, etc.) should be within print specifications
Finishes should be of quality to meet print RMS
Proper cutters are to be used to achieve maximum production and the desired finishes to print specifications
Parts should be free of burrs and, unless otherwise stated, sharp edges broken
Fixtures should be placed on machine for proper holding or workpiece

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Operate Special Types of Milling Machines	I. Special Milling Machine Operations (a) Speeds and feeds (b) Depth of cuts (c) Materials being cut (d) Types of cutters (e) Operations of machine (f) Particular parts machine is designed to machine (g) Special fixtures (h) Lubricants (i) Safety precautions	Special Milling Machine I. Maintenance II. Tool Care III. Speeds and Feeds IV. Housekeeping V. Fixture Selections VI. Safety

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Shaper-Planer Operations

TASK: (No. 7.1) Shaper-Planer

COMPETENCY: Given a part, select the correct tools, set up, operate, and complete a shaper-planer operation (horizontal, vertical, or angular) to the specified tolerances of the drawing

CRITERION MEASURE:
The finished shaper-planer operation will maintain parallel and perpendicular surfaces
Finish will be to the required RMS or AA
The correct fractional and decimal tolerances will be maintained
The part will be free of burrs and sharp edges

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select Proper Feeds and Speeds and Make Adjustments	I. Principles of Feed and Speed Selection (a) Calculate speed (b) Calculate feed (c) Calculate stock removal (d) Understand cutting speeds for different materials (e) Adjustment principles of position, length, and overtravel	Shaper-Planer I. Housekeeping II. Safety III. Proper Use of Machine IV. Maintenance V. Adjustments VI. Sharp Tool VII. Quality of Work
II. Shaping or Planing an Internal or External Keyway	II. Keyway Shaping (a) Types of keyways and fits (b) Types and sizes of cutting tools (c) Coolants and application (d) Tolerances and measurement	
III. Shaping or Planing a Contour Layout Lines	III. Contour Shaping (a) Tool geometry (b) Cutting tools for irregular shapes (c) Type of material	

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OUTLINE OF INSTRUCTIONAL CONTENT (CONTINUED)

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
IV. Shaping or Planing Horizontal, Vertical, or Angular Surfaces	IV. Shaping Surfaces (a) Types of vises (b) Leveling and squaring (c) Clamping (d) Materials being machined (e) Proper tooling (f) Speeds and feeds (g) Coolants application (h) Uses of angle plates and sine bars	
V. Shaping or Planing Using Index Heads	V. Index Heads (a) Principles of index head (b) Set up and uses (c) Divisions of circles	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Precision Grinding

COMPETENCY: Given a grinding machine, lubricate it according to the service instructions, mix and apply coolant, and clean the machine properly

CRITERION MEASURE: The lubrication oil will be identified as to the proper viscosity as prescribed by the manufacturer
The coolant mixture will be sufficient to keep the part cool and provide lubrication of the cutter

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Clean and Lubricate the Grinders	I. Principles of Cleaning and Lubricating and Care of Grinders (a) Types of grinders (b) Nomenclature (c) Lubricant and lubrication (d) Coolants and application (e) Safe practices and procedures	Precision Grinding I. Housekeeping II. Lubrication III. Storage IV. Maintenance V. Coolant mixture VI. Lubrication records VII. Protection of blueprint

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Precision Grinding (continued)

COMPETENCY: Given a grinding machine, locate and identify the main switch and all auxiliary power switches

CRITERION MEASURE:
The grinders main power supply will be learned
The wheel motor switch will be identified
The workhead switch will be identified
The table travel switch will be identified

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
II. Operate the Machine Controls	II. Principles of Machine Controls (a) Start and stop switch (b) Coolant controls (c) Speed and feed controls (d) Table reversing and dovell controls (e) Magnetic chuck controls (f) Control sequencing	VIII. Switch Locations IX. Feed and Speed Controls

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Precision Grinding (continued)

COMPETENCY: Given a grinding machine, select and mount the grinding wheel in the prescribed manner

CRITERION MEASURE:
The grinding wheel will be identified by the markings
The grinding wheel will be checked for cracks
The grinding wheel will be the proper size for the machine

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
III. Select Correct Wheel, Install and Adjust all Safety Devices	III. Principles of Selecting and Mounting Wheels (a) Types of grinding wheels (b) Sizes and shapes of grinding wheels (c) Wheel material and construction (d) Wheel mounting procedures (e) Safe practices and procedures	X. Wheel Storage XI. Handling XII. Mounting XIII. Balancing XIV. Safety Measures
IV. Check for Imperfections	IV. Imperfections in Wheel (a) Method of holding wheel (b) Tapping with proper tool	XV. Wheel Identification

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Precision Grinding (continued)

COMPETENCY: Given a grinding machine, dress the wheel according to the job requirement

CRITERION MEASURE:
The dressing tool will be chosen and used properly
The dressed wheel will have the desired finish to cut properly
The wheel will produce minimum vibration in the grinding operation

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
V. Truing and Dressing the Grinding Wheel	V. Principles of Truing and Dressing Wheel (a) Type and size of wheel and dressing tools (b) Wheel dressing and truing procedures (c) Safe practices and procedures	I. Eye Protection II. Dressing Attachment III. Housekeeping IV. Maintenance of Wheel Dressing Work V. Accuracy

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Precision Grinding (continued)

COMPETENCY: Given the necessary equipment, balance the grinding wheel to the prescribed limit

CRITERION MEASURE:
The balanced wheel will be within the prescribed limit
The wheel will be mounted securely to the holder using the correct blotters
The wheel will be mounted to the grinder being careful not to damage it

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
VI. Balance Wheel	VI. Wheel Balancing Prinicples (a) Physical Science - Laws of Force (b) Wheel balance procedures 1) Balance stands 2) Balance techniques	I. Balance Mandrels II. Weights III. Excess Vibration IV. Eliminate Chatter V. Accuracy

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.1) Surface Grinding (continued)

COMPETENCY: Given a project, select the proper grinding wheel and complete a surface grinding operation to the specific tolerance of the drawing

CRITERION MEASURE: The finished surface grinding operation will maintain, parallel, and perpendicular surfaces
Finish to the required RMS or AA
Maintain the correct fractional and decimal tolerances
Be free of burrs and sharp edges

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
VII. Grind a Flat, Vertical Angular Surface	VII. Grinding Wheels (a) Types (b) Care and Uses VIII. Workholding Methods (a) Mechanical (b) Magnetic (c) Care and uses (d) Safe practices and procedures (e) Principles of operation	Surface Grinding I. Grind Patterns II. Motor Sound III. Table Control IV. Finish V. Coolant VI. Measurement VII. Quality of Work VIII. Housekeeping

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.2) Centerless Grinding

COMPETENCY: Given a project part, select the correct grinding and regulating wheel and complete a centerless grinding operation to the specific operation on the drawing

CRITERION MEASURE: The finished centerless ground part will maintain finish to the prescribed RMS or AA
Roundness to close tolerance normally expected from centerless grinding
No chatter marks or flat spots on the work

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Mount Regulating Wheel	I. Regulating Wheel (a) Wheel material and construction (b) Wheel size and shape (c) Wheel mounting procedure (d) Safe practices and procedures	Centerless Grinding I. Housekeeping II. Proper Grinding Wheels III. Proper Balance of Wheels IV. Proper Tool Rest V. Coolant VI. Safety VII. Visual Aids VIII. Guards IX. Wheel Storage X. Maintenance XI. Wheel Dressing XII. Quality of Work XIII. Relation to Other Operations
II. Set up and Grind through Feed to a Shoulder, Taper, and contour	II. Principles of Centerless Grinding (a) Grind bar adjustment (b) Wheel dressing procedure 1) Grinding wheel 2) Regulating wheel (c) Work feed methods (d) Safe practices and procedures	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.3) Cylindrical Grinding

COMPETENCY: Given a project part, select the proper grinding wheel and complete a cylindrical grinding operation to the specified tolerance on the drawing

CRITERION MEASURE: The finished cylindrical ground part will maintain straight and round surfaces on the diameter of the work
Finish as specified
Tolerance as specified

OUTLINE OF INSTRUCTIONAL CONTENT Part to stay sufficiently cool to prevent annealing or warping

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Grind External Surfaces (a) Straight (b) Tapered (c) Contour (d) To a shoulder	I. Principles of Grinding External Surfaces (a) Wheel dressing procedure (b) Workholding methods (c) Wheel and work speeds (d) Feeds (e) Work measurement (f) Safe practice and procedures	I. Cylindrical Grinding II. Handling finished parts III. Visual Aids IV. Charts and posters V. Guards VI. Maintenance of equipment VII. Quality of work VIII. Relation to other operations
II. Set up and Grind Internal Surfaces (a) Straight (b) Tapered (c) To a shoulder	II. Principles of Grinding Internal Surfaces (a) Wheel dressing procedure (b) Workholding methods (c) Wheel and work speeds (d) Feeds (e) Work measurements (f) Safe practices and procedures	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.4) Internal Grinding

COMPETENCY: Given a partially completed project part select the proper grinding wheel and complete an internal grinding operation to the specified tolerance on the drawing.

CRITERION MEASURE: The finished internally ground part will maintain straight and round surfaces on the internal surface of the work.
Finish as specified.
Tolerance as specified. Part to stay sufficiently cool to prevent annealing or warping.

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select the correct wheel, install and adjust all safety devices	I. Selecting and installing grinding wheels	
II. Dress and true a wheel	II. Dressing and truing	
III. Grind internal diameter straight through	III. Straight through internal grinding	
IV. Plunge grind and face a shoulder	IV. Plunge grinding	
V. Grind an internal taper	V. Taper grinding	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.5) Tool and Cutter Grinder

COMPETENCY: Given a group of cutters, select the proper grinding wheel and set up and sharpen several different types of cutting tools to the required specification

CRITERION MEASURE: The finished ground tool should have the prescribed clearance angles
Cutting edges will be ground to the specified finish or better
Completed cutter will be coated or wrapped to protect cutting edges and provide safe handling

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Grind (a) Milling cutters (b) Reamers (c) Special tools	I. Principles of Tool and Cutter Grinding (a) Wheel shape (b) Finger location 1) Table 2) Head (c) Clearance angles (d) Gullet grinding (e) Workholding attachments 1) Centers 2) Adaptors 3) Attachments (f) Safe practices and procedures	Tool and Cutter Grinding I. Sharp Tools II. Wheel Rotation III. Excess Pressure IV. Position of Operator V. Hand Safety VI. Eye Safety VII. Housekeeping VIII. Quality of Work IX. Relation to Other Operations X. Maintenance of Equipment

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.6) Bench and Pedestal Grinding

COMPETENCY: Given a workpiece (drill or tool blank), select the proper grinding wheel and complete an off-hand grinding operation to the proper dimensions on design

CRITERION MEASURE: The finished groundpart should maintain the prescribed clearance angles
Cutting edges will be ground to the required finish
Tool rest on grinder will be set a maximum of 1/8" from wheel

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Off-Hand Grind (a) Drills (b) Lathe tools (c) Hand Tools (d) Deburr parts	I. Principles of Hand Grinding (a) Work rest and spark arrester adjustment (b) Angles and clearances (c) Proper techniques (d) Safe practices and procedures	Off-Hand Grinding I. Coolant II. Tool Rests III. Lighting IV. Quench V. Foot Protection VI. Quality of Work VII. Relation to Other Operations

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.7) Buffing and Polishing

COMPETENCY: Given a project part, select the proper wheel and compound, complete a buffing polishing operation to the desired finish

CRITERION MEASURE: The finished project will be within the minimum decimal and fractional tolerance after buffing and polishing
Finish to the specified finish or better
Part to be kept sufficiently cool to reduce annealing and warping

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select and Mount Buffing Wheel	I. Buffing Wheels (a) Types (b) Care and Uses	Buffing and Polishing I. Proper Use of Machine
II. Select and Use the Proper Compounds	II. Buffing Compounds (a) Types (b) Uses (c) Finishes (types)	II. Cleaning III. Safety IV. Quality of Work
III. Buff a Flat Surface	III. Operation of Machine (a) On-off (b) Guard placement (c) Work holding methods (d) Work on wheel pressure	V. Housekeeping VI. Relation to other operations VII. Maintenance of equipment

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.8) Lapping (Hand & Machine)

COMPETENCY: Given a project part, select the proper lapping compound and lap the project part to the specified tolerance of the drawing

CRITERION MEASURE: The finished lapped part will be flat to tolerance specified

The finished lapped part will blue fit to total area as specified

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select Proper Compounds or Tools	I. Hand and Machine Lapping (a) Selection of lapping compound (b) Blueprint reading and interpret part-finish specification (c) Materials (d) Shapes (1) round (2) flat (e) Lapping oils (f) Safety precautions	Lapping I. Care of Machine II. Housekeeping III. Visual Aids IV. Lubrications V. Selection of Proper Attachments for the Job
II. Properly Charge Plate	II. Principles of Charging a Lap (a) Methods of charging (b) Techniques of charging (c) Safe practices and procedures	VI. Compounds VII. Oils VIII. Safety IX. Quality of Work X. Relation to Other Operations
III. Lap a Cylindrical Plug or Hole	II. Principles of Charging a Lap (a) Methods of charging (b) Techniques of charging (c) Safe practices and procedures	
III. Lap a Cylindrical Plug or Hole	III. Principles of Cylindrical Plug/Hole Lapping (a) Motions (b) Effects of heating (c) Adjustment for wear & sizing (d) Techniques of lapping (e) Safe practices and procedures	

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OUTLINE OF INSTRUCTIONAL CONTENT (CONTINUED)

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
	IV. Principles of Flat Lapping (a) Scoring (b) Motion 1) Reciprocating 2) Rotational (c) Effect of heating (d) Safe practices and procedures	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Abrasive Machining

TASK: (No. 8.9) Honing

COMPETENCY: Given a project part, select the proper honing stone and hone a hole to the size and finish desired

CRITERION MEASURE:
The finished honed part will be round to specified tolerance
The finished honed hole will meet the specified size tolerance
The finished honed hole will be finished to specified RMS or better
The part will be free of burrs and sharp edges

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Select Proper Speeds and Settings	I. Principles of Speeds and Settings (a) Adjustments for wear (b) Types of material (c) Finish (d) Honing oils (e) Safety precautions (f) Proper grits	I. Abrasive Machining (a) Maintenance of equipment (b) Housekeeping (c) Visual aids (d) Lubrications (e) Selection of proper hone for the job (f) Oils (g) Compounds (h) Safety (i) Relation to other operation (j) Quality of work
II. Select Proper Stones		
III. Hone Holes Straight and True		

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Specialized Machining Processes

TASK: (No. 9.1) Profiler or Pantograph

COMPETENCY: Given a project of engraving a name plate, or three dimensional object, set up, select tools, set speeds and feeds and complete specifications to sample, sketch or drawing

CRITERION MEASURE: The part will meet specifications as to finish, dimensions and overall appearance

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Operate Profiler or Pantograph	I. Set up and Operate Profiler or Pantograph (a) Set up procedures (b) Cutting tools (c) Speeds and feed (d) Templets (e) Safety precautions	Profiler or Pantograph I. Safety II. Housekeeping III. Care of Tools IV. Maintenance of Equipment V. Quality of Work

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Specialized Machining Processes

TASK: (No. 9.2) Numerically controlled machining

COMPETENCY: Drill, tap and mill a slot in a plate to print or sketch specifications using set up procedures, selecting tools, speeds and feeds, loading and unloading tapes and inspect the part for conformance to specifications

CRITERION MEASURE: Inspect plate for hole size, tapped hole, length and width of slot, and position of holes and slot in plate. Check for overall appearance finish

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Operate N/C Machine	I. Set up and Operate N/C Machine (a) Set up procedures (b) Cutting tools (c) Speeds and feeds (d) Programming (e) Coordinate system of measurement (f) N/C control unit (g) Tape loading and unloading (h) Safety precautions	Numerical Controlled Machining I. Proper Use of Machine II. Housekeeping III. Safety IV. Care of tools V. Quality of work VI. Maintenance VII. Storage of tapes or cards

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Specialized Machining Processes

TASK: (No. 9.3) Electrical Discharge Machine

COMPETENCY: Select a part, set up the machine, select electrodes, set machine for current rate, select coolant, feed rate and machine part to print

CRITERION MEASURE: Inspect part for correct dimensions and specifications according to print

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Operate EDM Machine	I. Set up and Operate EDM Machine (a) Set up procedure (b) Electrodes (c) Current requirements (d) Coolants (e) Feed rates (f) Safety precaution	Electrical Discharge Machine I. Proper Use of Machine II. Housekeeping III. Safety IV. Care of Electrodes V. Maintenance VI. Finishes

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Specialized Machining Processes

TASK: (No. 9.4) Jig Borer and Grinder

COMPETENCY: Given a project and rough machine mold cavity, set up machine, select feed and speed and finish grinding

CRITERION MEASURE: The part will meet specifications as to finish, dimensions and overall appearance

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up and Operate Jig Borer and/or Grinder	I. Set up and Operate Jig Borer and/or Grinder (a) Set up procedures (b) Cutting and grinding tools (c) Speeds and feeds (d) Temperature control (specialized care) (e) Safety precautions (f) Coolants or lubrication	Jig Borer or Grinder I. Safety II. Housekeeping III. Care of Tools IV. Maintenance of Equipment V. Quality of Work

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Applied Metallurgy

TASK: (No. 10.1) Identification of Materials

COMPETENCY: Identify a piece of ferrous metal by finish, spark test, and color code
The student will identify a piece of non-ferrous metal by magnetic test, corrosion appearance, color code, and material appearance

CRITERION MEASURE: Compare ferrous steel with a positive known sample
Compare non-ferrous part with a positive known sample, test with magnet, and perform identification tests

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Identify Ferrous Metals	I. Identify Ferrous Metals (a) Basic elements (b) Production of ferrous metals (c) Types of iron (d) Types of steel (e) Uses	Applied Metallurgy I. Relation to Major Area of Study II. Audio-visual Aids
II. Identify Non-Ferrous Metals	II. Identify Non-Ferrous Metals (a) Basic elements (b) Production of non-ferrous metals (c) Types of non-ferrous metals (d) Alloys of non-ferrous metals (e) Uses	III. Safety IV. Housekeeping V. Maintenance VI. Records and Reports

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Applied Metallurgy

TASK: (No. 10.2) Heat Treatment

COMPETENCY: Given specimen to be treated, perform the heat treatment required to achieve the specified results

CRITERION MEASURE: By use of spark test, chemical test, and color code examination determine the structure of material
Charts or tables should be used to determine exact temperatures to use for the particular structure being heat treated
Tempering temperatures and length of time in the furnace (as stated by the tables or charts) should be used to achieve correct hardness stated

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Harden Metal	I. Harden Metal (a) Identify metal (b) Temperatures (c) Quenches (d) Purpose of (e) Equipment and materials (f) Use of data	Heat Treatment I. Safety II. Charts for thickness III. Charts for temperature IV. Maintenance V. Housekeeping VI. Visual Chart VII. Records and Reports
II. Anneal Metal	II. Anneal Metal (a - d) same as above	
III. Temper Metal	III. Temper Metal (a - d) same as above	
IV. Normalize Metal	IV. Normalizing (a - d) same as above	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Applied Metallurgy

TASK: (No. 10.3) Testing

COMPETENCY: Given known test specimens, test to determine structure, hardness and tensile strength

CRITERION MEASURE:
Inspect material to insure tests are correctly administered
Clean part for accurate test
Visual checks for cracks and bends
Use correct equipment for testing
Use tables and charts
File test

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Test Hardness	I. Test Hardness (a) Testing equipment and uses (b) Hardness specifications	Testing I. Visual Check
II. Test Tensile Strength	II. Test Tensile Strength (a) Preparation of specimens (b) Testing equipment and uses (c) Tensile specifications	II. Safety III. Records and Reports IV. Housekeeping
III. Test Shear	III. Test Shear (a) Preparation of specimens (b) Testing equipment and uses (c) Shear specifications	
IV. Test for Cracks V. Check for Warpage	IV. Test for Cracks (a) Methods of testing (b) Equipment and materials	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Blueprint Reading and Sketchings

TASK: (No. 11.1) Blueprint Reading

COMPETENCY: Given a print or sketch, read the blueprint to determine dimensions, specifications, tolerances, and shop notes for the part

CRITERION MEASURE: Print is read correctly

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Visualize the Shape of an Object	I. Visualize the Shape of an Object (a) Orthographic projection (b) Line identification	Blueprint Reading I. Relation to Major Area of Study
II. Determine Dimensions	II. Determine Dimension (a) Line identification (b) Relationship of views (c) Fraction, decimal, and angles (d) Limits and tolerances	II. Visual Aids III. Neatness IV. Quality of Work
III. Interpret Specifications	III. Interpret Specifications (a) Title block information (b) Bill of materials (c) Notes for changes	
IV. Interpret Title Block Information		

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Blueprint Reading & Sketching

TASK: (No. 11.2) Sketching

COMPETENCY: Sketch a part using lines, making sketches of necessary views, dimensions, specifications, limits and tolerances, shop notes and title block information

CRITERION MEASURE: Compare part to sketch for neatness and to determine if the part can be machined from sketch

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Make Sketches	I. Make Sketches (a) Orthographic projection (b) Alphabet of lines (c) Dimensioning	Sketching I. Care and Storage of Paper and Equipment
II. Make Working Drawings	II. Make Working Drawings (a) Drafting instrument and uses (b) Orthographic projection (c) Alphabet of lines (d) Dimensioning (e) Specification (f) Limits and tolerances (g) Scales (h) Geometric construction	II. Selection of Projects to Sketch III. Neatness IV. Quality of Work

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Mathematics

TASK: (No. 12.1) Arithmetic

COMPETENCY: The student will perform functions of arithmetic by applying it to tasks in the shop and classroom and tests and examinations

CRITERION MEASURE: Application of arithmetic in the shop and test grades

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Perform Basic Operations	I. Perform Basic Operation (a) Add, subtract, multiply, divide (b) Common fractions (c) Decimal fractions (d) Metrics (e) Calculator	I. Arithmetic (a) Application (b) Step by step procedures (c) Accuracy (d) Relation to major area of study
II. Perform Advanced Operations	II. Perform Advanced Operations (a) Ratio and proportion (b) Square roots and recipricals (c) Percentage (d) Simple formulas	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Mathematics

TASK: (No. 12.2) Algebra

COMPETENCY: Perform functions in basic algebra with single unknowns

CRITERION MEASURE: Use basic algebra in shop

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Perform Basic Operations	I. Perform Basic Operation (a) Add, subtract, multiply, divide positive and negative values (b) Real number, general numbers (c) Simple equations (d) Roots	I. Algebra (a) Application (b) Step by step procedures (c) Accuracy (d) Relation to major areas of study

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Mathematics

TASK: (No. 12.3) Geometry

COMPETENCY: Perform basic geometric functions

CRITERION MEASURE: Applies concepts using geometric shapes in the shop

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Perform Basic Operations	I. Perform Basic Operations (a) Use of handbook or equivalent (b) Areas of polygons (c) Areas of circles	I. Geometry (a) Application (b) Step by step procedures (c) Accuracy (d) Relation to major area of study

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Mathematics

TASK: (No. 12.4) Trigonometry

COMPETENCY: Perform basic trigonometric functions with single unknown

CRITERION MEASURE: Applies basic trigonometric concepts in shop

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Perform Basic Operation	I. Perform Basic Operation (a) Function of angles (b) Use of tables (c) Right triangle	I. Trigonometry (a) Application (b) Step by step procedures (c) Accuracy (d) Relation to major area of study

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Mathematics

TASK: (No. 12.5) Use of Machinery Handbook

COMPETENCY: Use the Machinery Handbook by applying tables, charts, formulas and technical data in daily use for shop projects

CRITERION MEASURE: Uses handbook to find appropriate information

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Use of a Solution of Formulas	I. Formulas (a) Index (b) Selection of proper formula (c) Necessary math to solve formula	I. Machinery's Handbook (a) Relation to major area of study (b) Value as a goal (c) Care of book
II. Use of Charts and Tables	II. Charts and Tables (a) Index (b) Selection of proper table or chart (c) To read table or chart	
	III. Measurements 1. Use of index 2. Special measuring techniques (a) Pin method of measuring gears (b) Three wire method of measuring threads (c) Special gauges 3. Necessary math to make special calculators	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Welding

TASK: (No. 13.1) Oxyacetylene

COMPETENCY: Select a soldering project, prepare the surface, select the flux, select filler material and solder the project.
Select a brazing project, prepare the surface, select the flux, select filler material and braze the project.
Select a welding project, propose the workpiece, select rod and weld the project.
Cut object according to print specification.
SEE NEXT PAGE FOR CRITERION MEASURE

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Perform Soldering Operations	I. Perform Soldering Operations (a) Assemble and setup (b) Preparation of materials (c) Fluxes (d) Flame control (e) Temperature controls (f) Safety precautions (g) Selection of filler materials (h) Torch positioning (i) Disassembly and storage	I. Oxyacetelyne Welding I. Relation to Major Area of Study II. Safety III. Housekeeping IV. Quality of Work V. Care of Equipment VI. Store Equipment
II. Perform Brazing Operations	II. Perform Brazing Operations (a - d) same as above)	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Welding

TASK: (No. 13.1) Oxyacetylene (continued)

CRITERION MEASURE:
Inspect flow of filler material, for adherence, excessive buildup, weak spots,& appearance
The student will set up torch for cutting operation, cut and prepare weld test plates
Inspect weld test plates for correct angles, size, and finish
Inspect tightness for fitting, setting of gauges, size of tip, and lighting the torch
Take project apart and inspect for cleanliness of part, pits in filler material, and amount of filler material used
Inspect for flow of filler material, adherence of filler material to part and test project for strength The student will select a project, prepare the material, select filler material, and weld the part

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
III. Perform Welding Operation	III. Perform Welding Operations (a) Assembly and setup (b) Preparation of materials (c) Flame control (d) Temperature control (e) Selection of filler materials (f) Safety precautions (g) Fusion (h) Torch positioning (i) Disassemble and storage	
IV. Perform Cutting Operations	IV. Perform Cutting Operations (a) Assembly and setup (b) Preparation of materials (c) Flame control (d) Torch positioning (e) Safety precautions (f) Disassemable and storage	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Welding

TASK: (No. 13.2) Arc Welding

COMPETENCY: Set the welding machine for correct current, ensure ground connection positive, proper clothing, take safety precautions, strike an arc, and weld a part

CRITERION MEASURE: The student will select the proper electrode by using a print with welding specifications as to size and grade
Inspect electrode as to specifications, size, and grade
The student will prepare material for weld test plate, weld plate, clean slag, remove backup strip, saw coupons, grind surfaces, and chamfer
Inspect for pits, slag, and form coupons to specifications. Inspect for cracks and penetration of filler material to parent metal

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Set up Equipment	I. Set up Equipment (a) Current setting (b) Connection of ground cable (c) Proper clothing and protective equipment (d) Safety precautions	Arc Welding I. Relates to Major Area of Study II. Safety III. Housekeeping IV. Quality of Work
II. Selection of Electrodes	II. Selection of Electrodes (a) Materials to be welded (b) End use of finish product (c) Size and specification numbers (d) Welding symbols	
III. Perform Welding Operation	III. Perform Welding Operations (a) Preparation of work pieces (b) Striking of arc (c) Position of work piece (d) Position of electrode (e) Arc control (f) Direction of movement (g) Flux removal and cleaning	

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ANALYSIS

CURRICULUM: Machinist

SUBJECT AREA: Communications

TASK: (No. 15.1-2) Listening and Talking

COMPETENCY: Listen, understand and interpret instructions and theory in the class room and shop

CRITERION MEASURE: Demonstrate listening and understanding by correctly performing task and by instructing others properly. Ask the opinion of instructor on various ways to accomplish tasks

OUTLINE OF INSTRUCTIONAL CONTENT

SKILL/PROCESS	KNOWLEDGE/THEORY	VALUE/ATTITUDE CONCEPTS
I. Listening	I. Listening (a) To get the meaning (b) To get the information (c) To get the (d) To understand a person (e) To share feelings (f) To understand instructions II. Talking (a) Talk to instruct (b) Talk to report on work, progress, events, meetings (c) Talk to describe tasks to be performed, equipment to use (d) Talk to solve problems, convince of feasibility, technical reports (e) Talk to get ideas across persuade, change behavior	Listening and Talking I. Need for Communications II. Achieving Cooperative Goals

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